All tutorial files can also be downloaded from: **www.3dartistonline.com/files**

www.3DArtistonline.com

3DArtist

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Practical inspiration for the 3D comr

SCOTT EATON EXCLUSIVE

ANATOMY SECRETS

The master uncovers industry advice, sculpting techniques and more

Incredible portraits

Bring your characters to life with a professional Polypainting workflow in ZBrush

Create hot game assets

Get your models ready for videogames with a step-by-step tutorial by Gavin Goulden

DIGITAL DOUBLES

Framestore and Digital Domain reveal how to convincingly replicate even the most famous of faces

38 PAGES OF TUTORIALS INSIDE

Animate vehicles

Jahirul Amin's expert guide for Maya, complete with project files

The revolution will be printed

Explore the remarkable evolution of 3D-printing technology and how it's being used in the industry

Tips for better topology

José Alves da Silva explains how TopoGun can quickly spruce up models

Master arch vis in 3ds Max

Create picture-perfect scenes with credible reflections

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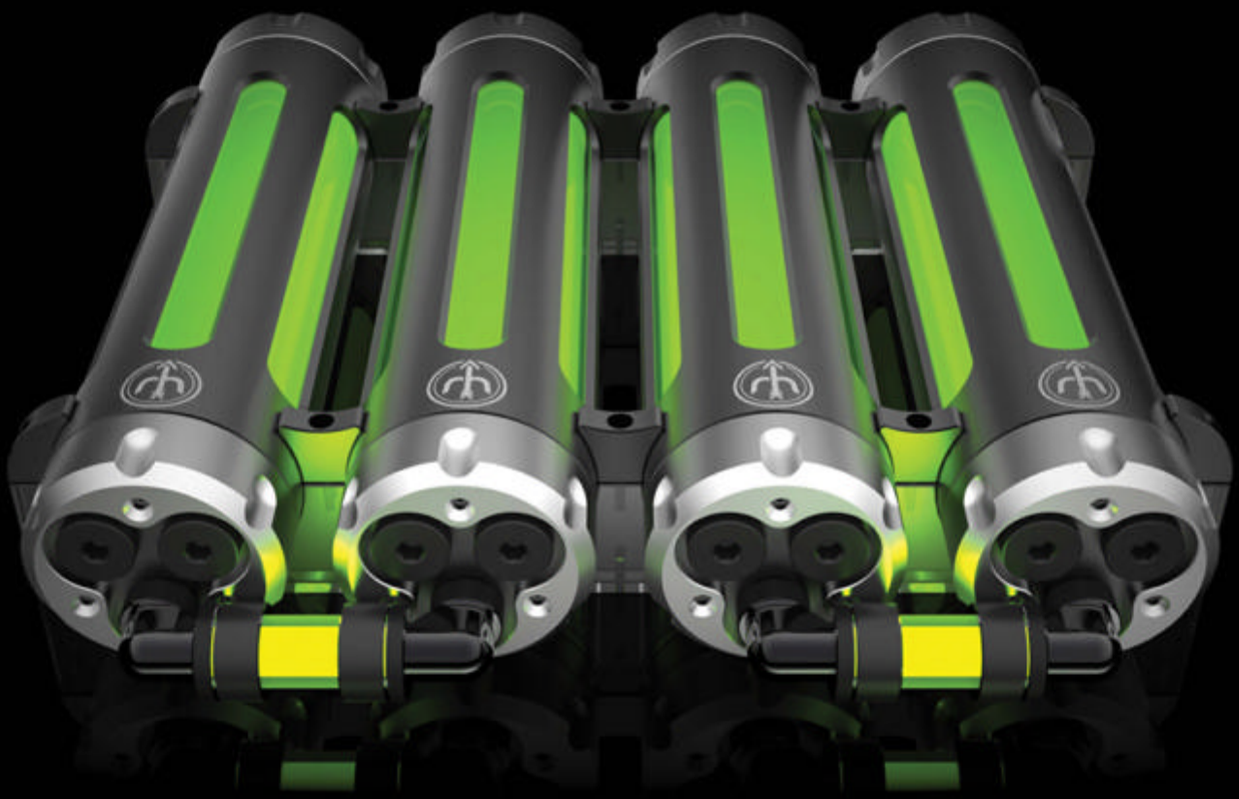


Model by Red Harbinger
redharbinger.com

www.keyshot.com

> “I have to know what’s in there. I do that by drawing, which is fundamental to my work”

Scott Eaton reveals his career so far and shares his top tips **Page 24**

Anatomy is a hot subject with 3D artists right now. If you’re serious about your craft, it’s not enough to just know how your tools work. If you want to impress your clients and audience, you need something more. While many of us may wince as we attempt to pronounce the peculiar names of the bones and muscle groups that make up the human body, we can’t deny that a sound understanding of human anatomy is crucial to the success of any character artist’s work.

Scott Eaton has truly mastered the art of anatomy and is one of the most prestigious artists working in the field of digital sculpture today. Watching him at work he appears to effortlessly perform like a traditional sculptor within the confines of 3D software, creating some of the most true-to-life works we have ever seen. From hero horses to Cyclops characters, Eaton uses his incredible knowledge of the human form, with a limited toolset in ZBrush, to replicate reality and realistically present mythological creatures as fast as he thinks.

We may very well shrug with defeat as we look at this incredible talent before us, but there’s an important note that we should all remember: the trick is in acquiring the knowledge of what you’re trying to sculpt – sketching references and spending time figuring out what is going on mechanically. Eaton has reached this level of quality by laying the foundations and putting in the time. Serious time. For him, too, it was once awkward and slow. Eventually the pieces of the puzzle will start to fit together and become more of an unconscious process as you work. This issue we are excited to talk to Eaton to garner his top advice and learn from his valuable experiences.

Scott Eaton
7-page feature interview
Page 24

You can go behind the scenes with a pro digital sculptor this issue, as we take a look at Scott Eaton’s career and portfolio. He also reveals a few of his tips and tricks to help the rest of us find the key to our own successes. Turn to page 24 to get started.

Welcome

to the magazine and 116 pages of amazing 3D

Every issue you can count on...

1. **Exclusively commissioned art**
2. Behind-the-scenes guides to images and fantastic artwork
3. **A CD packed full of creative goodness**
4. Interviews with inspirational artists
5. **Tips for studying 3D or getting work in the industry**
6. The chance to see your art in the mag!

If you're working in the 3D industry – or have always wanted to – it's essential to know both your tools and subject matter inside and out. And that's where **3D Artist** magazine comes in...

This issue we get to know the super-talented Scott Eaton to find out how he established himself as one of the pioneers of digital sculpture. Between his art and design projects, creating visual effects for films and teaching anatomy classes to the pros, his portfolio is a masterpiece in itself. Discover his top tips on page 24 and check out our Masterclass for realistic anatomy by Gustavo Åhlén on page 76. If that's not enough, you can push your skills further still with Adam Fisher's ZBrush workflow for character busts on page 50. Enjoy!

Lynette

This issue's team of expert artists...

Scott Eaton

When we bumped into Scott in London and saw his incredible workflow, we wanted to know more about this remarkable talent

Simon Dominic

We've drafted Si's fantastic mind in to create some striking character concept art for our 3D artist to translate in ZBrush

Adam Fisher

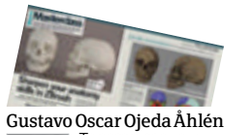
Our games-industry expert willingly takes on the colourful artwork of Simon Dominic and makes it more awesome in 3D

Gavin Goulden

Gav has had an exciting few months with the release of *BioShock Infinite*. He returns to reveal how to create game assets

Jahirul Amin

Our Maya guru is back to finish up his immense vehicle series. This time: animation! The results are truly impressive



Gustavo Oscar Ojeda Åhlén

To accompany our anatomy feature with Scott Eaton, Gustavo swings by to teach us a few of his tricks for realistic anatomy

Ross Board

Here to reveal a few key secrets to better arch-vis renders, Ross drops into 3ds Max to help us add new levels of detail to scenes

Brett Murrah

Discover Brett's wonderful medical illustrations and learn how he creates a simple 3D scan effect in LightWave

Magyar László

Magyar László has a stunning portfolio of works crafted in CINEMA 4D. This issue he reveals his top texturing tips

Craig A. Clark

Excited by the new version of KeyShot Pro, Craig has compiled a handy tutorial to help us create better renders

José Alves da Silva

We can never get enough of José. This time he's here to show us how TopoGun can be used to quickly improve our models

Daniele Orsetti

When Daniele heard the MARI 2 announcement, we could barely hold him back! Find out his verdict in the reviews

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www.3dartistonline.com

3DArtist

Imagine Publishing Ltd
Richmond House, 33 Richmond Hill
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www.3dartistonline.com
www.greatdigitalmags.com

Magazine team

Deputy Editor Lynette Clee
lynette.clee@imagine-publishing.co.uk
☎ 01202 586239
Editor in Chief Dan Hutchinson
News Editor Chris McMahon
Sub Editor Tim Williamson
Senior Designer Chris Christoforidis
Photographer James Sheppard
Senior Art Editor Duncan Crook
Head of Publishing Aaron Asadi
Head of Design Ross Andrews

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Contributors
Gustavo Oscar Ojeda Åhlén, José Alves da Silva, Jahirul Amin, Orestis Bastounis, Ross Board, Michael Burns, Craig A. Clark, Simon Dominic, Scott Eaton, Adam Fisher, Gavin Goulden, Magyar László, James Morris, Brett Murrah, Joe Nazzaro, Daniele Orsetti, Poz Watson

Advertising
Digital or printed media packs are available on request.
Head of Sales Hang Deretz ☎ 01202 586442
hang.deretz@imagine-publishing.co.uk
Advertising Manager Jennifer Farrell ☎ 01202 586430
jennifer.farrell@imagine-publishing.co.uk
Advertising Sales Executive Ryan Ward ☎ 01202 586415
ryan.ward@imagine-publishing.co.uk

Cover disc
Head of Digital Mat Toor
Multimedia Editor Steven Usher
3daxtrahelp@imagine-publishing.co.uk

International
3D Artist is available for licensing. Contact the International department to discuss partnership opportunities.
Head of International Licensing Cathy Blackman
☎ +44 (0) 1202 586401
licensing@imagine-publishing.co.uk

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Circulation
Head of Circulation Darren Pearce ☎ 01202 586200

Production
Production Director Jane Hawkins ☎ 01202 586200

Founders
Group Managing Director Damian Butt
Group Finance & Commercial Director Steven Boyd
Group Creative Director Mark Kendrick

Printing & Distribution
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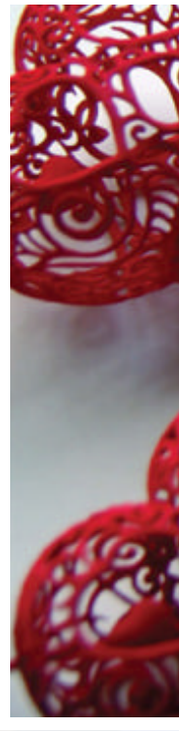
The master of anatomy

"I'm sure my understanding of engineering influences my thinking about anatomy, because in the end human anatomy is literally just mechanics"

Scott Eaton discusses his career successes and future plans



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Learn to craft incredible portraits in ZBrush

Post-production tricks for top-class arch vis

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Media Molecule reveals its charming new game, *Tearaway*

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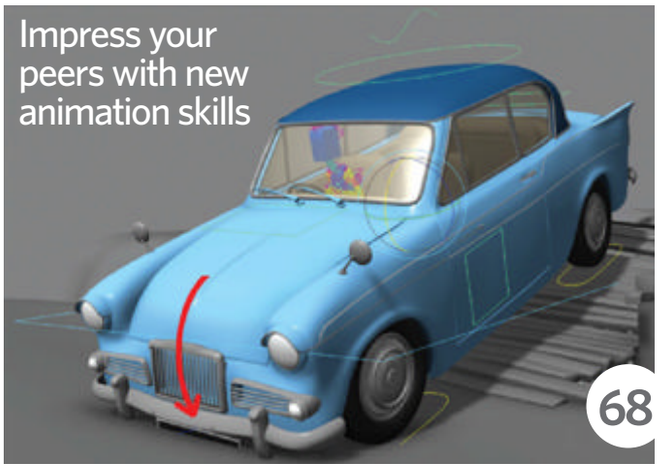

Impress your peers with new animation skills

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"I have more time to create, rather than produce. Other than having to wait for my pieces to get printed and shipped, it's hard to argue with the benefits"

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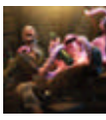

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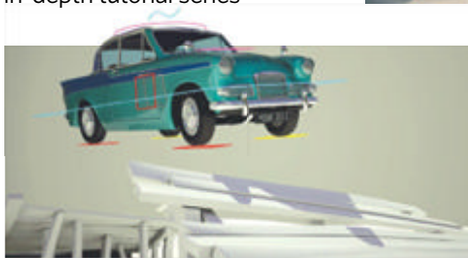

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With the Disc

- KeyShot 4 & Octane Render software trials
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- Free HDRI from CGAxis
- 2.5 hours of video tuition
- Magazine tutorial files

Turn to page 112 for the complete list of the disc's contents

WELCOME TO

THE GALLERY

Seven pages of great artwork from the 3D community

Images we love!

Artist info

Yannick Moulin

3DArtistonline

Username: Sirius42

Personal portfolio site http://yannickmoulin.wordpress.com

Country France

Software used 3ds Max, V-Ray, Photoshop, After Effects

Work in progress...

3DArtist Loves

"This is such a charismatic piece. The volumetric lighting is used cleverly to direct the viewer around the scene – much like a spotlight on a stage. We love those beady eyes staring out at us, too"

Lynette Deputy Editor

Have an image you feel passionate about? Get your artwork featured in these pages

Create your gallery today at **www.3dartistonline.com**

Or get in touch... 3dartist@imagine-publishing.co.uk @3DArtist Facebook.com/3DArtistMagazine

"I used a wall-builder script by Clovis Gay (http://rauquenrol.over-blog.com) to make the walls... GuruWare was also helpful to generate vines and leaves – you simply place the pointer where you want to grow the vine"

Yannick Moulin, *Horde*, 2013

Create your free gallery today at 3DArtistonline.com
Share your art, comment on other artists' images

3DArtist Loves

"It's hard not to love the textures and materials in this scene, which bring the character and his surroundings to life. The lighting also helps describe the atmosphere beautifully"
Lynette Deputy Editor

"The concept behind this is 'Believe', an allusion to the fact that [our studio] can generate *any* image for clients"
Fescher Neoilustração, *Proudnocchio,* 2010

Artist info

Fescher Neoilustração

3DArtistonline
Username: Fescher

Personal portfolio site
www.fescher.com.br
Country Brazil
Software used Blender, ZBrush, 3ds Max, Photoshop

Work in progress...

Artist info

José Alves da Silva

3DArtistonline

Username: zeoyn

Personal portfolio site
www.artofjose.com

Country Portugal

Software used
ZBrush, 3ds Max, V-Ray

Work in progress...

3DArtist Loves

José always goes the extra mile to bring his stylised creations to life. We love how he's updated his workflow to introduce FiberMesh with 3ds Max. The V-Ray render is stunning as well!

Lynette Deputy Editor

"I knew about ZBrush's FiberMesh but hadn't used it in a project, so I forced myself to try it and explore ways to export the hair to 3ds Max. This allowed me to use 3ds Max's native Hair on top of FiberMesh's splines, then render in V-Ray"

José Alves da Silva, *Hairy Old Guy,* 2013

Artist info

Nikita Veprikov

Nikita is a talented 3D illustrator and concept artist creating a body of extraordinary work

Personal portfolio site
http://veprikov.com

Country Ukraine

Software used
3ds Max, ZBrush, Photoshop

Work in progress...

3DArtist Loves

This is so vibrant and exciting! Nikita clearly has an excellent eye for colour, lighting and composition to cleverly draw the viewer right into the action. Great work!

Lynette Deputy Editor

"This image was created as a gift for my best friend, who loves to cycle!"

Nikita Veprikov, *Chase*, 2013

3DArtist Loves

"Images that feel part of a larger story are always intriguing. You can imagine there's a narrative around this beautiful flower trapped by technology"

Chris News Editor

"I love steampunk and the factories of the 19th Century. So, basically, I was just creating what I like! I made the image in my spare time, just for fun and to improve my skills in 3D"

Denis Anfilov, *Steam Flower,* 2013

Artist info

Denis Anfilov

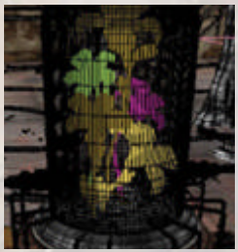
Denis is a Ukrainian artist currently working for SphereGraphic studio

Personal portfolio site www.spheregraphic.com

Country Ukraine

Software used 3ds Max, ZBrush, Photoshop, V-Ray

Work in progress...



Artist info

Wong Wei Jian

This lighting and CG artist from Malaysia is currently working in the 3D industry in Singapore

Personal portfolio site
www.weijian-wong.cghub.com

Country Singapore

Software used
Maya, Photoshop, After Effects

3DArtist Loves

"The lighting and rendering work in this atmospheric piece is superb. In fact, it's making us want to watch *Mad Men*..."

Chris News Editor

"I used this scene to practise my lighting. It took approximately ten days to create. I did all the texturing, shading, lighting and rendering, and the model was made by Giorgio Luciano"

Wong Wei Jian, *Old School Smoke*, 2012

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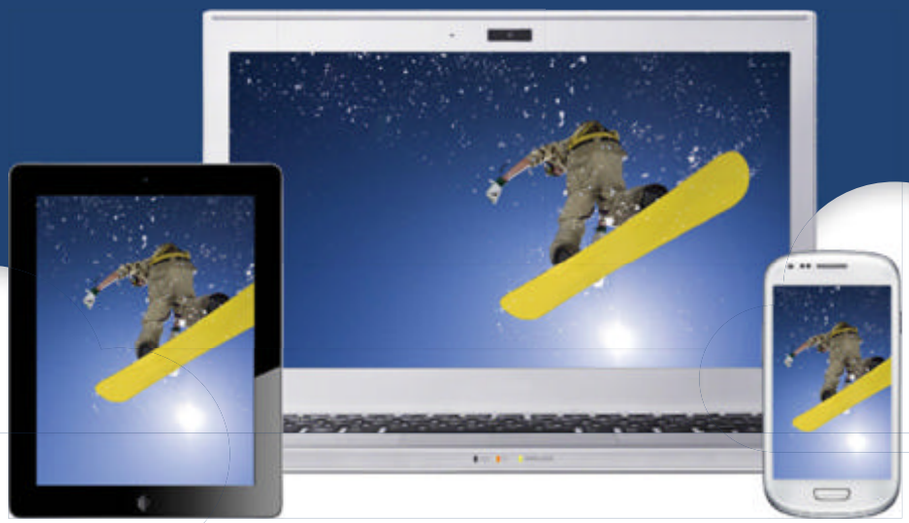

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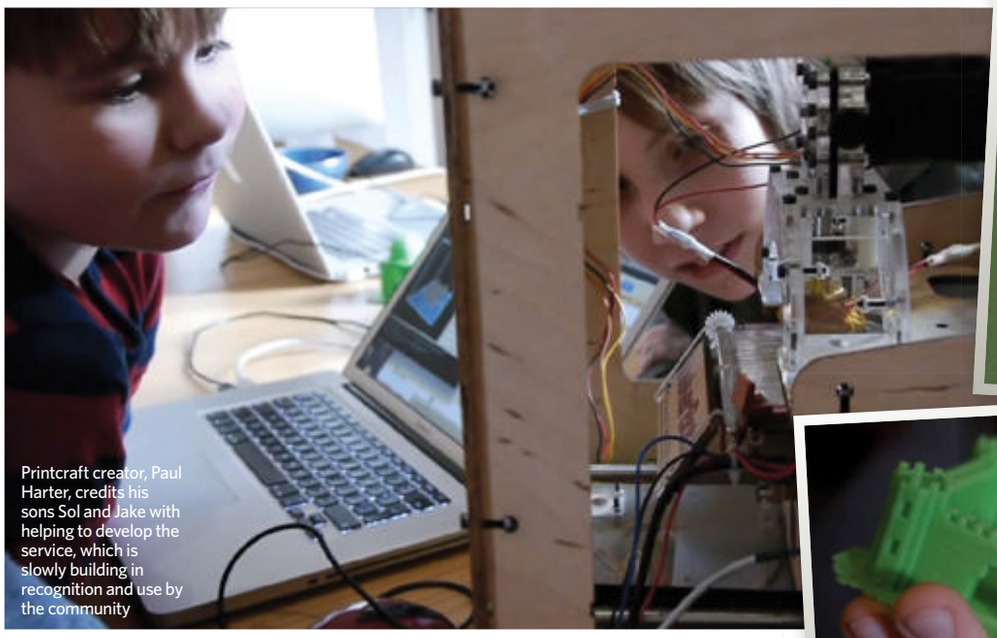
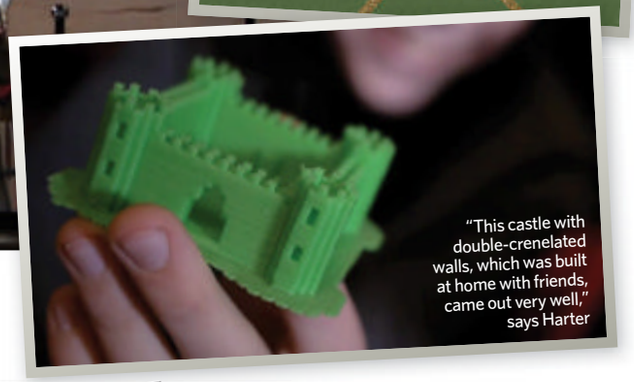


Printcraft creator, Paul Harter, credits his sons Sol and Jake with helping to develop the service, which is slowly building in recognition and use by the community



"This castle with double-crenelated walls, which was built at home with friends, came out very well," says Harter

3D printing becomes child's play

Printcraft helps Minecraft designs burst out into the real world

***Minecraft* is easily one of the most popular videogames today – something made all the more pleasing by the fact that its gameplay is rooted in creation, rather than destruction.** Players of any age can build almost anything they can imagine, thanks to an extremely simple approach to game design. Until now these creations have existed only in the digital world. However, if Printcraft has anything to do with it, that's all about to change.

"Printcraft was a project I started with my children," says founder and digital toolmaker Paul Harter. "I have a one-tenth share in a MakerBot Thing-O-Matic printer, the first domestic 3D printer. When I brought it home for the first time, my two boys, Sol (age 8) and Jake (age 11), were very excited and wanted to start printing. However, the available tools to design objects required too much learning, so they quickly got bored and went back to building things online with their friends in *Minecraft*.

"The solution was simple," he continues. "To print the things that they were making in *Minecraft*, I wrote a small JavaScript to pull models out of the game, which could then be converted into STL files using OpenSCAD."

Harter has a live *Minecraft* server that anyone can use, with digital plots for children to build models. To make them ready for print, they only need to write their email on a *Minecraft* sign and hit an in-game button. The STL file will then be emailed to them.

"I think the potential for children creatively using 3D, especially with gaming, is enormous," says Harter. "Printcraft lowers the barrier for young children wanting to start creating digital models. Many of them already have the necessary skills from playing videogames, but even those who don't can very quickly master *Minecraft*'s simple block-building interface. Such an easy tool can act as a stepping-stone to advanced modelling tools such as Tinkercad or Trimble SketchUp."

Printcraft has just received funding from Nesta, Mozilla and the Nominet Trust to develop the project further. Harter intends to use the extra money to make Printcraft a more accessible experience and to develop the tool as an educational resource.

Learn more at http://printcraft.org. To make and print your own creations, join the *Minecraft* server at eu1.printcraft.org.

> "Printcraft lowers the barrier for young children wanting to start creating digital models"
>
> **Paul Harter,** Printcraft creator

CAD gets simplified

Harter discusses the benefits of Minecraft in CG design

"*Minecraft* already has many qualities that make it brilliant as a design tool. It has a culture of collaborative creation. Children play and build together online, swapping technical and design tips. Within the *Minecraft* community there is already an amazing amount of impressively creative models being built.

"An interesting technical aspect of using a gaming engine like this is that Printcraft is the world's first collaborative voxel CAD modelling tool... [This is because] *Minecraft* already resolves all the players' actions on the server and distributes the result in real-time. It possibly has exciting implications for the design of new professional CAD tools."

Artist spotlight

3D creature prints

Blizzard Entertainment's Dominic Qwek talks us through his monstrous designs

Dominic Qwek www.dominicqwek.com

Dominic Qwek is currently working as a senior cinematic artist at Blizzard Entertainment. He's worked on such triple-A titles as *Killzone 2* and *StarCraft II*, yet he also specialises in creating digital sculptures for 3D printing. Here he discusses some of his favourite designs and 3D prints.

Cornelius "This was an alien creature I designed that looked like a goat and had aquatic features. This is an actual photograph of the painted kit. I sculpted him in ZBrush and printed him in 3D. The paintwork by Rick Cantu turned out amazing and I was really satisfied with [the result]."

Hopper "With this I decided to sculpt in ZBrush with a specific end in mind. I wanted to build a sculpt with a base and have the bust look like it was fused to this. I added in details such as veins and muscle mass growing into the rock-like base. The paintwork was by Rick Cantu."

Rakshasa "After having made *Cornelius* and then *Hopper*, I wanted to [illegible]ll-torso bust and print it out. *Rakshasa* is loosely based on a [illegible]ating creature from Hindu mythology. A lot of time was put into the musculature and posing of this character. This also happens to be one of my larger 3D prints, standing at 11-inches tall."

Ulrich on the importance of good forms

"I think the most important things are the fundamentals of the sculpture. If your main form and proportions are okay, then it's hard to mess up afterwards. I really love traditional sculpture and how forms can capture the essence of someone or something, so detailing isn't always [as vital]."

Ulrich does his organic modelling in ZBrush and his hard-surface work in Maya

3D Sketchbook

Up-close & personal

Dan Ulrich discusses how he achieves incredible detail in his work

Dan Ulrich www.danulrich.com

Videogame cinematics artist Dan Ulrich has been working in the entertainment industry since 2005 and it shows in his incredibly detailed work on human sculpts. "I like to start by researching the subject I'm working on and gather as much reference as possible," he tells us. "The more [quality] references I have, the better, because any elements that I'm uncertain about will be spotted by the viewer first.

"DynaMesh is a great ZBrush feature to help with sketching, but nowadays I also do a lot of small Plastiline clay sketches. After having the concept down, I try to get a life model – or in the worst case, myself – and make enough reference pictures to get a solid understanding of the final pose.

"I work without using Symmetry most of the time, so I constantly need to measure and check cross-sections to avoid deformations," he concludes.

Get in touch...

Expert tools

Detailed designs

Freelance artist Kyoungmin Lee discusses the tools of his trade

Kyoungmin Lee www.kyoungminlee.com

Lee combines a number of the top CG packages to achieve his highly detailed models

"When I start a project, I normally refer to an existing piece of concept art, or simply come up with one. I usually start by making a mesh in 3ds Max or Maya, then begin sculpting in ZBrush. After finishing my character I will then use the Transpose in ZBrush for posing. In my opinion, ZBrush and Mudbox are both great programs to produce concepts, as well as form basic shapes and designs. I prefer to complete my final mesh in 3ds Max, however."

Inspiration corner

Sound & vision

How Woodwork used sound to inform a rich fantasy landscape

Woodwork www.woodwork.nl

The Woodwork team approached this project as if it were a movie

How do you approach a trailer for a collection of orchestral samples? If you're Dutch VFX studio Woodwork, then you do it by creating sweeping fantastical landscapes that mirror the tracks themselves.

"We wanted to create a journey through an impossible world – a trailer without an actual movie," says Woodwork's creative director Marvin Koppejan of the advert for *Lumina Symphobia 3*. "Since the audio is very diverse, the scenery had to be rich enough to support the different types of music.

"At first we illustrated all of the shots using Photoshop," Koppejan continues. "After we had the shots in order, we decided which techniques were best for each one. A couple were built up from actual plate footage, which we then motion-tracked and dressed with matte paintings and 3D elements, such as the flying birds...

"For other shots, like the castles, we built the environment in 3D using LightWave, [which] gave us more control over the camera movement and the depth of the shot." You can view the full short at http://woodwork.nl.

The only briefing Woodwork was given by the client was a pack shot with the tagline 'The Story Unfolds'

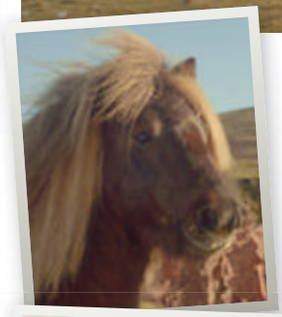
The 3D Artist CG Student Awards 2013

The awards are in full swing with exciting involvement from the VFX community

The 3D Artist CGSAs have already received a fantastic array of student submissions, which are currently viewable at http://cgstudentawards.com. "The 2013 awards are off to a flying start with amazing content being uploaded daily from all corners of the globe," says founder Andrew McDonald. "Our confirmed judging panel is comprised of key industry professionals from Pixar, Weta Digital, Ubisoft, Double Negative and more. To top it off we have Guillaume Rocheron, the Oscar-winning VFX supervisor for *Life of Pi*, on the panel. From a student's perspective, you couldn't ask for a better opportunity to get exposure."

Prizes include Digital-Tutors' subscriptions, top software, internships and much more!

Prosthetic model pony limbs were built using resin. These legs were then used in the edit to cut between close-up dancing and the long shots of the CG pony



Behind the scenes

Dance, pony, dance

MPC's moonwalking creation for 3 Mobile

MPC www.moving-picture.com

Ever wanted to watch a Shetland pony moonwalk to Fleetwood Mac's *Everywhere*? Well, thanks to MPC, now you can.

"One of the biggest challenges was getting the movements to look totally realistic – difficult considering ponies never moonwalk!" says VFX creative director Jake Mengers. "A digital double of the pony was created in CG to enable us to cut between CG and real life. This required very precise attention to detail to ensure the matches were seamless."

The pony – who was dubbed Socks by the team – was created using MPC's in-house Furtility tool, a hair program that has been used on many of its film projects in the past.

A huge amount of environmental work was also completed, with extra elements such as birds and waves added and sky replacements used to correct the inclement weather. You can see the full short at http://moving-picture.com.

3DArtist

CG STUDENT AWARDS

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WWW.CGSTUDENTAWARDS.COM

A

B

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to view great art & chat
to like-minded artists

Images of the month

These are the illustrations that have been awarded Image of the Week on 3DArtistOnline.com in the last month

A Glaurung & Turin
» Francesc Camós
3DA username fcamos
Francesc says: "This image is based in Tolkien's mythology and inspired by the works of John Howe, Alan Lee and Ted Nasmith. It has been made with ZBrush, Softimage, MARI and Photoshop. This is the end result."
We say: *And what an epic result! We all love a good fantasy piece and it's the atmosphere in this image that really ties all the elements together to bring the scene to life.*

B Morgan Aero 8 Custom
» Alexandr Novitskiy
3DA username Tigersfather
Alexandr says: "The classic British car, Morgan, has a very special design. I made this model for a customer, who will assemble a real one in his garage. I made some variants of the model and renders for myself, to show the car with a different mood."
We say: *This super-sexy shot is fantastic for showing off the beautiful curves of the Morgan. We love the added atmospheric effects in the backdrop, which bring a little drama and helps the mustard yellow pop.*

C Chihuahua Love
» Rudy Massar
3DA username rudymassar
Rudy says: "I love adding a certain amount of exaggeration and emotion in my work. With this piece, the Chihuahua shows that the tough guy has a gentle heart. D'awww!"
We say: *This is just too adorable. The stylisation really works with this bust to sell the character's expression with a simple material. Having the vest a different shade and the bright-red heart helps lift the image too.*

D Romanovs II
» Finger Industries
3DA username Finger Industries
Finger Industries says: "We took our Romanovs characters and introduced them to the real world – using 3ds Max, HDR lighting, V-Ray and a touch of Photoshop. They're being animated right now too!"
We say: *These characters really look like they belong in the environment, thanks to some awesome compositing tricks. The excellent lighting also makes all those realistic textures and materials nice and tactile. We can't wait to see them come to life in an animation!*

C

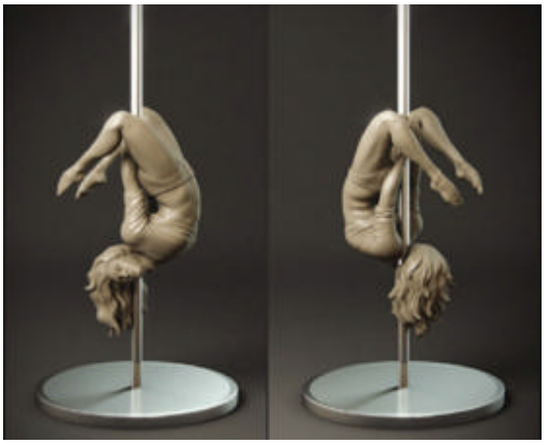
Image of the month

I love my helmet

» **Yny Sting**
3DA username YN.YUAN
Yny says: "Created in ZBrush with Photoshop."
We say: *While this image isn't a final render, the incredible materials and delicate posture of this charming little lady deserve a mention in the gallery this month. You can find Yny's work in progress online at www.3dartistonline.com/user/YN.YUAN.*

Fat Zombie

» **Josh Crockett**
3DA username Monsterfaces
Josh says: "This was created in ZBrush and Photoshop as an experiment with asymmetry. I wanted to see what I could come up with using no symmetry at all. This fat zombie was the result."
We say: *This awesome zombie looks like he's had more than his fill of human flesh. That belly is well and truly ready to explode! The awkward pose and presentation of this character really sell his personality, too.*



Pole dancer

» **Adam Sacco**
3DA username Soulty
Adam says: "This 3D model was created for a large 3D print from a reference photograph. Keeping the same centre of gravity that the female had in the photo was key to the model holding up as a 3D print."
We say: *Adam really shows off his fantastic understanding of anatomy with this piece. The model is cleverly balanced, so that it looks stable enough for a successful print.*

Daiichi

» **Hasan Bajramovic**
3DA username hbajramovic
Hasan says: "Daiichi is the leader in his unit. He excels in the art of the sword and his hand-to-hand combat skills are hard to match. His powerful combination of power and speed – that's further enhanced by his suit – gives him the perfect balance and makes him a tough opponent."
We say: *This is the kind of character design that forces you to zoom in and revel in all the wonderful details, from the rubber patterns on the suit to the skin texture and stubble.*

Have your say

Email, Tweet or get in touch with us on Facebook to share your thoughts, opinions and proudest projects

digital-tutors **www.digital-tutors.com** is a learning resource site boasting a library of 20,000 video-based CG lessons

THE AUTHOR OF THIS ISSUE'S STAR LETTER WINS A MONTH'S FREE SUBSCRIPTION TO DIGITAL-TUTORS WORTH $45 US

Star letter

Big aspirations

Hello, after endless hours of watching *The Lord of the Rings* Appendices discs... and absolutely falling in love with Weta Digital's work, I became incredibly interested in the CG and 3D world. One day, my father came home with a massive-looking publication from the newsagents – it was your *3D Art & Design - Vol 2* book.

I read that thing cover to cover about five times that night, I reckon. Now I've got a 3D Artist magazine subscription and I still love it. I'm currently 18 and have decided that my life goal is to work for Weta Digital one day. As I've recently been delving into animation in Maya – and absolutely loving it – I've decided I have to be an animator there.

Could you possibly write a tutorial or point me in the right direction of one that's going to help me with my rigs in Maya? I've noticed, while watching different people's videos, that in their rigs they have different channels in the Channel Box that are associated with certain parts of their rig. For example, when you select the foot, it may have a Toe Bend channel that can be adjusted... Basically, I'd *love* to know how I can go about achieving this. So, if you could help?

Much love from Australia,

Joshua, by email

Hi Joshua, thanks for your email! We've covered rigging in Maya a fair bit in previous issues of 3D Artist. Issues 44, 45 and 46, for example, all had great tutorials on creating realistic control rigs in Maya. You'll find more tutorials like this in the 3D Art & Design Book 2.

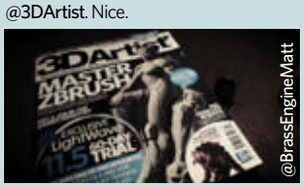
As our Star Letter winner, your prize is a month's free subscription to Digital-Tutors, where you'll be able to discover plenty more Maya tuition. Enjoy!

3D Art & Design Vol. 2 is now sold out, but you can check out *The 3D Art & Design Book* for tutorials, tips and advice. Visit **http://tinyurl.com/bookazine**

Top tweets

Get involved... @3DArtist

@BrassEngineMatt Finally home. Ready to put my feet up with the latest @3DArtist. Nice.



@chutes_the_bear @3DArtist Really excited to test out LightWave 11.5, only to find no disc with the mag :(

@3DArtist @chutes_the_bear Oh no!!!! Has someone stolen it? :(Please write to us as we may have a spare: 3dartist@imagine-publishing.co.uk

@WinstonHHuff @3DArtist Love the latest issue of the magnificent; except for all the glue used to affix the CD to the cover ;) Anyway, thanks for a great read

@SteveTalkowski @TheFoundryVFX @3DArtist Would LOVE to try MARI 2.0, but it's not OS X :(

Topology breakthrough

Hi Lynette, I wanted to say thank-you for such a wonderful magazine. I really loved issue 52 with 50 tips on topology – it was fantastic. For a long time it was something I kept away from because I just could not get my head around it. I couldn't understand the importance of quads until I watched some extremely useful tutorials on subdivision modelling in CINEMA 4D and it really opened my eyes! I no longer use Boole objects or just hack and slash my meshes. I know what to do to get a nice clean hole in an object and how to properly use control loops or edge loops. It's one of those gems you pick up along the road to becoming a better artist... Now I understand ZBrush and MODO so much more! I wanted to see how far I could push what I have learned, so here's a link to a new project I added to my portfolio: www.behance.net/gallery/Papa-Genes-Control-Room/7621575.

Today I had my first interview with others showing interest in my work. I cannot thank you enough for printing my letter and awarding me a month's subscription to Digital-Tutors. Keep up the great work!

Pauly, by email

Thanks for sharing your work Pauly, it's looking great! We're very pleased to hear that the Digital-Tutors subscription worked out for you and we're super excited that the topology feature was so helpful. It's always lovely to see what our readers are up to and find out what they think of the magazine. Please be sure to update your free reader's gallery on ***3DArtistOnline.com*** *so we can check out your progress.*

Pauly wanted to create as many properly modelled objects as possible. He's especially proud of the panel with the cushioned sides, featuring levers and valves on the copper vents

CD assets

I've just subscribed to a half-year digital version of 3D Artist mag on the iPad, but I can't find a way to download the CD content of each issue. Can you please tell me the way to download it?

Thanks very much,

Ryan, by email

Hi Ryan, we don't currently give the full CD contents to our digital readers, due to our agreements with our suppliers and the protection of their content. You can, however, download all the magazine tutorial files from ***www.3dartistonline.com/files****. This means you can still follow along with all the guides in the issue.*

DO MORE, DO IT IN...
ZBRUSH 4R5®
Image Courtesy of Piotr Rusnarczyk
Pixologic.com
ZClassroom.com
ZBrushCentral.com

ANATOMY SECRETS: SCOTT EATON

THE LONDON-BASED DIGITAL SCULPTOR WHO COMBINES CUTTING-EDGE TECHNOLOGY WITH TIMELESS TECHNIQUES

ON THE COVER

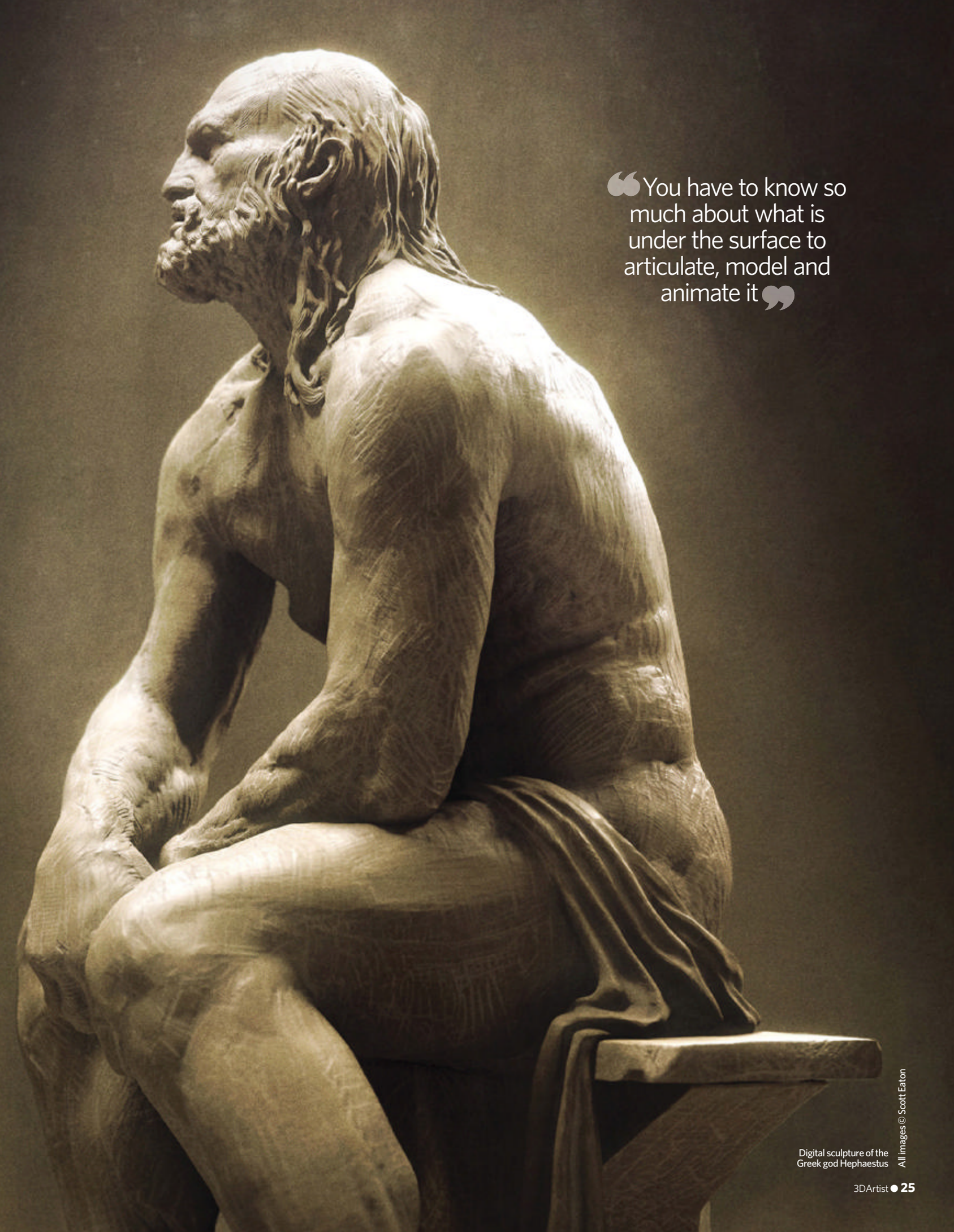
Scott Eaton's revised model of Antoine Houdon's *l'Ecorché* figure is the star of this issue's cover

For Scott Eaton, everything starts with a sketchbook. A pioneering artist in the rapidly growing field of digital sculpture – in which digital tools, 3D printing and fabrication are combined with traditional sculpting techniques – he still begins much of his creative work with simple design methods.

"I have to know what's in there," he explains. "I do that by drawing, which is fundamental to my work. ZBrush is probably the ultimate tool to output this work, but everything is resolved in my mind beforehand. In my sketchbook I work out exactly what that form is doing, what the pose will look like and how the anatomy works underneath.

"I have mountains of sketchbooks in my studio and most of the drawings are really bad, because they're me learning not to *be* bad. Some of my first drawings of horses look like dogs, for example, while others [seem to be] something not a horse," he continues. "This is because I didn't have an internal understanding of a horse's proportions, mechanics and anatomy..."

What sets Eaton's work apart from many of his contemporaries is his devotion to classical art and sculpting techniques, which informs even his most technical endeavours. "I've always been interested in figurative work," he notes. "My artistic explorations long preceded computer graphics, so everything I did was drawing, whether it was form, life or just being an artist and illustrator. There was no Photoshop or ZBrush, so for the most part my artistic development took place pre-digital. As a VFX artist, it's paramount to understand all of it, because you have to know so much about what is under the surface to articulate, model and animate it."



> “You have to know so much about what is under the surface to articulate, model and animate it”

Digital sculpture of the Greek god Hephaestus

All images © Scott Eaton

Anatomy secrets: Scott Eaton

ARTIST PROFILE

Name Scott Eaton

Job title Artist/designer

Location London

Website www.scott-eaton.com

Expertise Eaton is one of the pioneering artists in the emerging field of digital sculpting, which combines the power of digital tools with traditional sculptural techniques, 3D printing and fabrication. His background uniquely positions him to merge traditional and digital methods. He frequently gives talks on his work, including recent lectures at the Tate Modern, London. When not busy with his art and design projects, he creates visual effects for films.

Tools Sketchpad, ZBrush

Clients/employers Pixar, Industrial Light & Magic, LucasArts, Valve, Sony, Microsoft Game Studios, Ubisoft

Film credits *War Horse, Wrath of the Titans, Harry Potter and the Deathly Hallows, Captain America: The First Avenger, Clash of the Titans*

TIMELINE

2006 | SIGGRAPH – 'Pixar – Creating and Rendering a Greek God'

2008 | 'Bits to Atoms – The Process and Evolution of Digital Sculpture' lecture at Tate Modern, London

2009 | Anatomy Masters Evening: 'Comparative Anatomy for Artists', Gnomon School of Visual Effects, Los Angeles

2009 | 'Artistic Anatomy Masterclass', The Apollo Cinema, London. Sponsored by Escape Studios

2010 | Portraiture & Facial Anatomy Workshop, London

2010 | Digital Figure Sculpting Workshop, The National Animation and Design Centre, Montreal

2012 | Two-week-long anatomy course for ILM/Lucasfilm Animation in Singapore

2012 | L'Ecorché: Classical Anatomy for Artists iOS app goes on sale

2012 | *Venus of Cupertino* design iPad docking station appears at the London Design Festival

2013 | *Venus of Cupertino* goes on sale in high-end department stores

MASTERING FACIAL EXPRESSIONS

During a recent lecture, Eaton explained how he used ZBrush to create facial expressions for the Cyclops in *Wrath of the Titans*. "ZBrush [was] perfect for [this work], because if you have the right pipeline [to add to] the rigging setup, you can quickly layer up expressions," he explains.

"The secret is to use layers, with one expression per layer... As you're building the expressions you can create a neutral Morph Target. As you're making the adjustments, the Morph slider will enable you to tweak and actually animate the expression on and off, with the Morph Target between the expression you're sculpting and the neutral state.

"For example, if you're going to raise an eyebrow, you would sculpt that at the lowest subdivision, but you could step up your subdivisions to increase the resolution of the expression, adding accents, wrinkles, folds and all of these layers on top. You can export different stages of resolutions for the facial expression; maybe the lowest level for an animation rig, two subdivision levels for a rendering mesh and Displacement maps for an expression on top of that. This would leave you with a really quick flow for generating super-detailed facial expressions."

EARLY INFLUENCES

An artist since age 10 or 11, Scott Eaton was originally motivated by a childhood schoolmate who used to draw fantasy characters from the *ElfQuest* comic. "He was the one who really inspired me to start drawing," Eaton remembers. "My drawings were exceptionally primitive at the time because I had no experience, but I was enthusiastic and I think that was the important thing.

"Comics were also a considerable influence on my early ambitions. I thought I wanted to be a comicbook artist, so that was a lot of the figurative stuff I drew; some good, most bad, but it's [all a part of] the process of dispelling the ignorance of what the body is actually like.

"I remember all the things I struggled with at the very beginning and that's the stuff I teach in my anatomy courses. [These feature] all the epiphanies that I've had about how the body works and how I assumed it worked."

After studying Engineering and Art at Princeton University and the MIT Media Lab, Eaton continued his studies at the Florence Academy of Art. "I'm sure my understanding of engineering influences my thinking about anatomy, because in the end human anatomy is literally just mechanics. It was when I was studying mechanics that I got my first taste of computer graphics, which set me on the path to where I am now. It's amazing, using the power of the computer to make pictures."

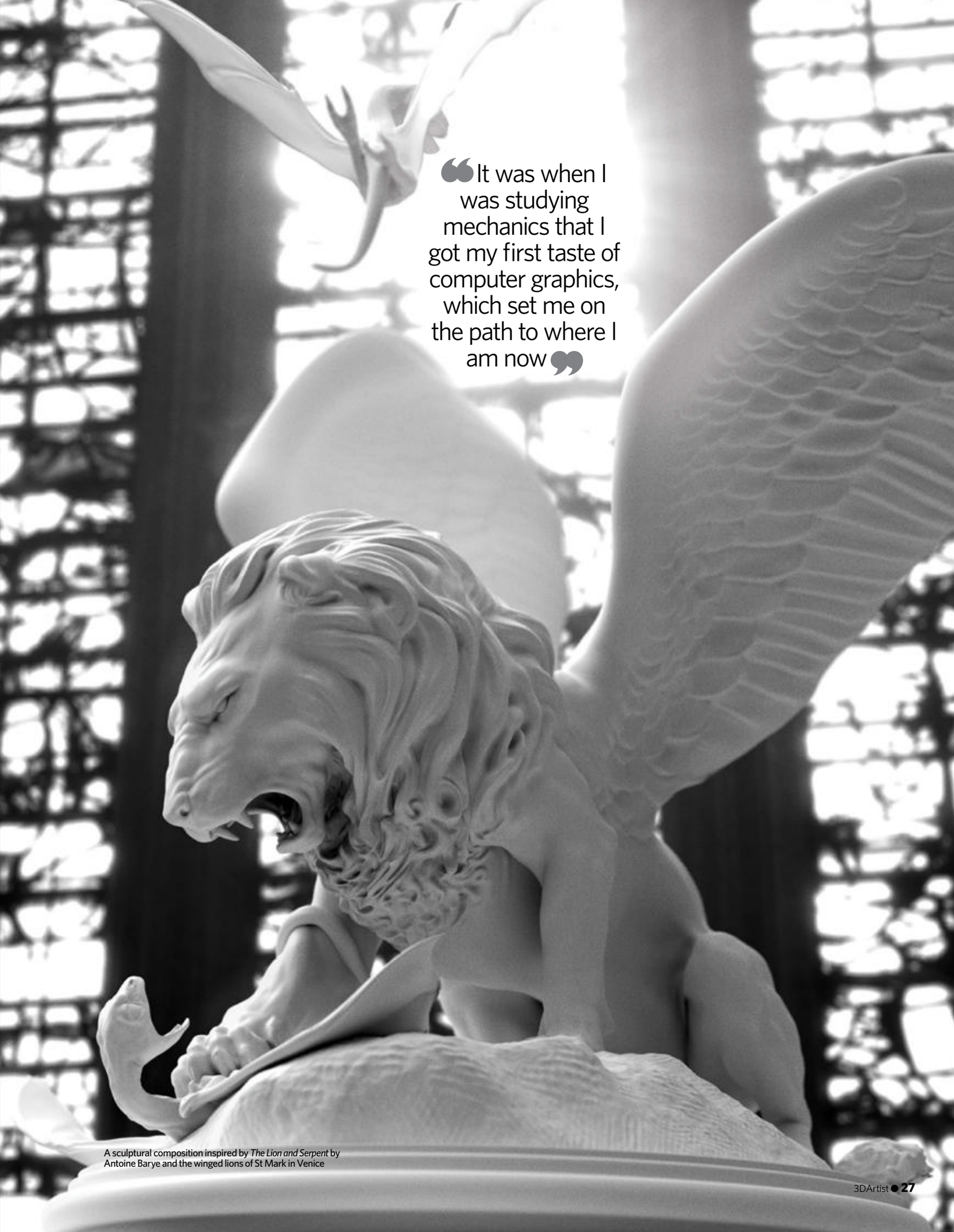
After moving to London armed with a healthy skillset and a few industry connections, Eaton eventually landed a couple of freelance jobs at The Mill and slowly began establishing himself in the industry. "The first half of my career was really in commercials, which allow for a lot of flexibility. It's a lot less constrained because of the turnaround time and the nature of the work, but when you move into features, you tend to get constrained very quickly. I chose to specialise in creatures and characters, modelling and supervision, so that covered all the bases for me."

While Eaton's talents were suited to creature design, one of the realities of the post-production industry is that most design work in features is generated early in the pre-production process. "In the odd case such as the Cyclops from *Wrath of the Titans*, where the designs weren't passed down from the art department, I could sometimes turn my hand to doing more concept work. A lot of post-production houses are trying to get a bit more into the concept-design stage, which makes sense. They have to build the creature, so they should probably contribute some of their expertise to the design."

FROM HARRY TO HORSES

In recent years, Eaton has been involved in a wide variety of film projects, including *Clash of the Titans, Harry Potter and the Deathly Hallows, Captain America, Wrath of the Titans* and *War Horse*. "I had very little hand in *Harry Potter* to be honest," he claims. "I was just having a look at some of the body-deformation stuff on the house elves, at a later stage in the production.

"*Captain America* [required] a big prosthetic replacement on the Red Skull for



> It was when I was studying mechanics that I got my first taste of computer graphics, which set me on the path to where I am now

A sculptural composition inspired by *The Lion and Serpent* by Antoine Barye and the winged lions of St Mark in Venice

Anatomy secrets: Scott Eaton

EMBRACE THE NUDGE BRUSH

"The Nudge brush [in ZBrush] is something I use when I'm doing facial expressions at the lowest resolution," Eaton explains. "When you're working on a facial expression at the lowest subdivision, you're essentially dealing with the sliding of the skin and the animation of the expression, so for most facial expressions you'll want to slide along the plane of the face or along the skull. The Nudge brush moves vertices along the plane of the mesh that they lie in, so I use it all the time for getting the action of the facial expression right, [as well as] the animated transition…

"Through the progressive subdivisions, I'll add the changes in volume or the wrinkles," Eaton continues. "The Nudge Brush in the level one subdivision is magic for getting the motion in the facial expression. Details will come with sculpting subsequently in higher subdivisions."

> "The benchmark for *War Horse* was total realism… Steven Spielberg was very sceptical at the beginning and tried to avoid digital horses anywhere he could, but in the end he did need them and loved our [results]"

An early piece (before ZBrush even had SubTools), this time re-imagining the Prometheus myth. In this interpretation Prometheus is bound with anchor chains, something more fitting a Titan of his status

his nose and some of his face. On *Clash of the Titans*, I [worked on] Medusa from concepts passed down to us, but otherwise it was taking that from start to finish. On the sequel, the look of the Cyclops was all mine from the very beginning to what they ended up looking like on the screen…

"With *War Horse* I was responsible for building and sculpting the digital horses for a few prominent shots in the film, so [this required] sculpting anatomically correct shapes for a horse in motion. That is actually the favourite of all my film projects."

Unsurprisingly, Eaton says there's a big difference between working on a realistic project like *War Horse* and a fantasy like *Clash*. "The benchmark for *War Horse* was total realism, in that we had to match the hero acting horse and make it [believable]. [This was a big] constraint on the project, but it was also a beautiful constraint. The result is hopefully seamless, so that people watching the film probably can't tell the digital horses, which is what we set out to do. Steven Spielberg was very sceptical at the beginning and tried to avoid digital horses anywhere he could, but in the end he did need them and loved our [results].

"With *Clash* and *Wrath of the Titans*, we were dealing with imaginary creatures, which was an interesting design challenge," Eaton continues. "I was trying to take everything I knew from real-life anatomy and design something a little bit fantastical, all while trying to keep it grounded in reality. In the end the only difference between that and *War Horse* is that when you see a Cyclops or Medusa, you immediately know it's CG… [However] you're still trying to convince people it's real, so there's a lot of satisfaction in making it look believable."

WAKING THE DEAD

The use of digital technology to create absolute realism has taken an interesting turn in recent months, with the Galaxy chocolate ad featuring the late Audrey Hepburn™. While the notion of resurrecting dead celebrities may seem slightly macabre, the efforts of the Framestore team are impressive nonetheless.

"With something like the Audrey Hepburn™ commercial (for which I did some early sculpting and the first Audrey™ maquette), to take it from [an early] stage to completion and not just comp in an actor, you'd [have to gather a] performance capture from someone to get all the subtleties of the human face…

"The thing is, we don't have sufficient fidelity to capture all of these subtleties as well as the timing of the human face. We can capture a lot of it on an actor in the step after that, which is a look-alike or an actor performing. This means we can take all of that data and retarget it to the actual shape of the departed actor being brought back.

"In the case of the Audrey Hepburn™ ad, maybe the cheekbones are a little wider, the eyes are a slightly different angle, the nose is smaller, the lips might be fuller and the chin is a little bit longer or shorter. All of these mechanical considerations go into retargeting the data; not just the motion data, but the actual shape produced on the surface of the model. A smile from a look-alike is not the same shape as a smile from Audrey Hepburn™, so there are large-scale adjustments in bone structure and smaller-scale adjustments in the musculature and fat. [This] means there are quite a few complex stages to go through, in the same way that sculpting the likeness of

Final Death of the Centaur maquette

a person is a difficult thing, because our eyes are so critical of it."

According to Eaton, eliciting a performance or even the likeness of one is even more challenging than capturing the likeness itself. "Because it's in motion, it can fall apart in a number of areas," he explains. "That's not even addressing things like developing the look, shading the skin, hair, eyes and compositing. There are a lot of other elements that make it equally difficult. The problem is, as emotional creatures, we attend to people's facial expressions with a disproportionate amount of our attention in the visual cortex, which means we're very quick to notice deficiencies in the face. This just makes the benchmark exceedingly high for plausible realism."

STATE OF THE ART

As an avid proponent of digital sculpture, Eaton has seen the technology continue to grow and yet it's the fusion of that technology with traditional artistic techniques that can create a recipe for success. "For me, ZBrush was the breakthrough tool," he elaborates. "Before that, the tools were always very crude, artistically speaking. When ZBrush came around I was a very early customer, because it offered potential beyond anything else, so I think I backed the right tool very early on. It's seen an amazing development with the guys at Pixologic and it's become an even more amazing, all-powerful, digital-sculpting tool that satisfies every [creative] need I have..."

"When I was at MIT, we had really expensive 3D printers, but I now have little MakerBot Replicators in my studio, which are probably equivalent in quality to what we had at MIT in the late 90s, so things have become cheap, miniaturised and it's just going to continue. That industry has really taken off, so the ability to design things digitally and output them is going to be increasingly common."

As far as learning classical anatomy techniques is concerned, Eaton believes there are far too many technical demands being made of digital artists, who often get absorbed by the computer too early. "People working in Maya have to learn all the details of Maya and ZBrush, as well as the sculpting in ZBrush," he explains. "There's a foundation of knowledge you need for working in CG or visual effects that takes a long time to mature and develop.

"I think maybe people do put computer skills before art techniques. They can certainly get a job with these skills, but their progress will be limited without the art skills and people are starting to realise that. A lot of the students I have on my anatomy courses are there for this very reason. They've realised the limitations in their knowledge and are doing something to correct that...

"There are now a lot of academies, not traditional art colleges, that are more like academically inspired workshops, where studios are doing the teaching. They're all over the place, so there's a huge interest now and I think it's making a comeback."

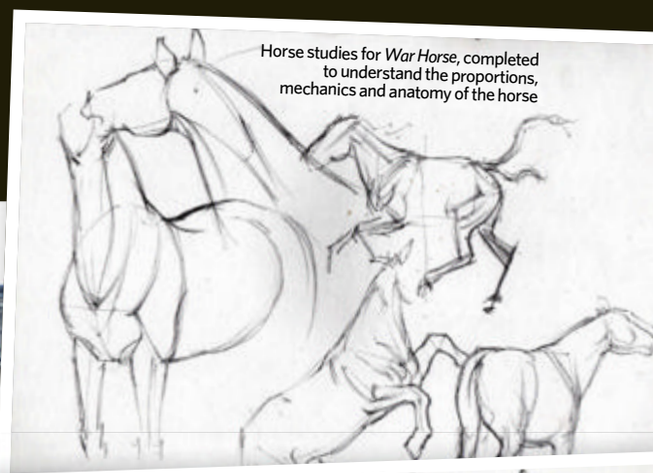
> "People do put computer skills before art techniques. They can certainly get a job with these skills, but their progress will be limited without the art skills, and people are starting to realise that"

THE FUTURE OF 3D PRINTING

An early advocate of 3D printing, Eaton believes the technology will continue to improve over the coming years. "It's getting fairly commonplace that people in the industry are dipping their toe in the water, so 75 per cent of artists will probably say 'yes' [to having 3D printed something] in just three years' time.

"I have a MakerBot Replicator that I use for prototyping my design pieces, like *Venus of Cupertino* and a few other projects in the pipeline. The Replicator I have is good for prototyping something on a small scale and checking it in three dimensions. I have a Hercules character I've been building, which looks good in ZBrush, but as soon as I print it up I notice things in the silhouette of the two-inch figure that I can't in ZBrush. I believe there's a feedback loop you get by prototyping something really small, bringing it back into ZBrush, reworking it and maybe printing it a little bigger the next time. It's an amazing technology that I've played with for a huge number of years."

Turner Prize-winner Mark Wallinger's *The White Horse*. Eaton contributed anatomy expertise (developed after studying hard for *War Horse* and other projects) as well as sculpting on the digital horse before fabrication

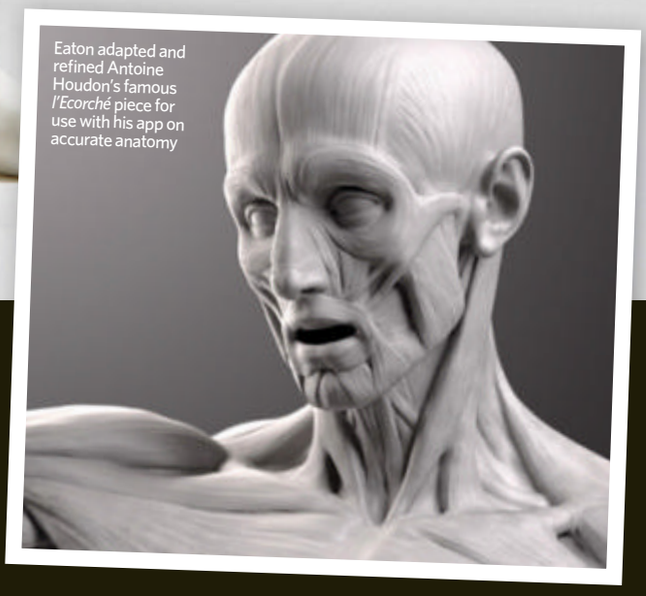


Horse studies for *War Horse*, completed to understand the proportions, mechanics and anatomy of the horse

Anatomy secrets: Scott Eaton

A still of the *Venus of Cupertino*

> "If you have an amazing idea, you just have to make it and see what happens"



Eaton adapted and refined Antoine Houdon's famous *l'Ecorché* piece for use with his app on accurate anatomy

NEW DIRECTIONS

Eaton currently divides his time between VFX work for features and a wide range of eclectic art and design projects. This includes an ongoing series of lectures, courses and workshops, as well as l'Ecorché, a new iOS app collaboration with legendary character sculptor Michael De Feo. "Michael ended up on one of my anatomy courses," he notes of the latter. "He really wanted some kind of project that would consolidate all of the knowledge he learned on the course, so proposed the idea of making the l'Ecorché app, which means without skin, or flayed in French.

"We kicked around a couple of ideas and I mentioned the Antoine Houdon *l'Ecorché* figure, which is quite a historically significant piece that's been used in academic art academies for hundreds of years. Michael set about finding some way to get a copy of it to scan and found a guy in upstate New York who had a plaster copy, so he scanned it and sent me the data.

"The thing about the Houdon piece is there are a few anatomical inaccuracies that really needed to be updated and corrected, so I spent most of my time not only increasing the resolution of the sculptural piece but also making it more accurate. The app is now a standard reference for students on my course, because it really shows all the forms, how they exist in 3D and how they interlock. For the next step of the project we're going to be producing it as a figure, so you will have a desktop reference as well."

One of Eaton's most unusual projects is *Venus of Cupertino*, an iPad docking station combined with a busty Venus figurine. As with much of Eaton's work, the piece began life as a rough sketch. After posting the sketch on his website and getting a huge response, Eaton made a digital prototype that quickly went viral in the design community. "I decided to make her properly, so that's how it evolved. She's now going to be stocked in some high-end department stores this summer, so if you have an amazing idea, you just have to make it and see what happens."

"My work is going in a few different directions right now", Eaton concludes. "I have a few commissions in progress for public installations that are going out in the next year or two. I'm also doing more design work like *Venus of Cupertino*, so there will be more projects on both fronts, as well as the VFX work. I also have a number of projects I want to accomplish in my own studio over the next few years, so there is plenty to occupy my time!"

TO DYNAMESH OR NOT TO DYNAMESH

"I think DynaMesh is really good for prototyping, but I don't like it so much for posing and things like that," says Eaton. "One of the big things I like about ZBrush is the subdivisions feature, [which enables you to start] with something very coarse in level one and subdivide it into a super-detailed, multi-million-polygon mesh at level eight... Through this hierarchy of subdivision, at level one you essentially have your mesh coarse enough and at a low enough resolution. You're then left with a big control cage where you can modify proportions and volumes with just the Move brush and a click of a vertex. You never get this with DynaMesh, which is always going to [require] quite a few polygons, [so] controlling the volumes becomes a little more of a free-form task.

"Typically, if you want to adjust the proportions or the thickness of somebody's chest or rib cage, you would be pulling around a couple of hundred-thousand points. [Alternatively] if you have a low-res subdivided cage at level one, you might be pulling around six vertices to get the contours and volume right. I love this feature and I [constantly] use it. DynaMesh is the right tool for some jobs, but it's not something I use all the time."

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THE REVOLUTION WILL BE PRINTED

The tide of 3D-printing technology is growing, flooding creative, medical and industrial markets with new ideas and possibilities

3D printing is not new. The concepts of additive manufacturing (AM) and rapid prototyping, which form the basis of this technological movement, have been around for almost three decades. However, the last few years have seen an acceleration in the public's awareness of the technology, as consumer services emerged to offer on-demand 3D printing to the masses. The cost of the technology also dropped enough to enable artists and designers to have a 3D printer in their own studio.

Current 3D printers work much like Inkjet machines. However, rather than ink they deposit material in successive layers to create a physical object from a digital file. One or more materials may be used (usually plastic, metal, ceramic or glass powder) and several processes exist, namely Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Fuse Deposition Modelling (FDM) and Stereolithography (SLA).

Previously only companies involved in CAD or industrial design work had access to the technology, but in 2008 a spin-off idea from designers at Philips Electronics launched as an online, on-demand, rapid-prototyping service called Shapeways (**www.shapeways.com**). When in 2009 MakerBot (**www.makerbot.com**) launched a DIY printer kit, the Cupcake CNC, the doors were opened for cheaper printers.

MakerBot estimated that in 2012 its devices represented 25 per cent of the overall 3D printer market, while in June of that year Shapeways-printed creations hit the one-million mark. Websites like **www.thingiverse.com** have sprung up, dedicated to the open-source sharing of user-created files and this year Formlabs (**http://formlabs.com**) aims to release the Form 1, a high-resolution, low-cost, SLA printer.

"The biggest development in 3D printing since its invention hasn't been technology-related," explains Samuel Bernier (**www.behance.net/samuelbernier**). "[The people behind] a 3D printer that costs less than €500 EUR (approx $644 US) to build were the ones that started this revolution."

The history of 3D printing

1984 Charles Hull develops the technology for printing physical 3D objects from digital data, patenting the technique as Stereolithography later in 1986

1986 Hull founds 3D Systems and develops Stereolithography Apparatus, the first commercial 3D-printing machine. This is followed two years later by the publicly available SLA-250

1988 Scott Crump invents Fused Deposition Modeling (FDM) and founds Stratasys a year later. The first FDM-based machine, 3D Modeler, is launched in 1992

1992 DTM sells its first selective laser sintering (SLS) system

2005 Z Corp. launches Spectrum Z510, the first commercially available, high-definition, full-colour 3D printer

2006 RepRap, an open-source project aimed at developing a self-replicating 3D printer, is initiated

2008 Objet releases the Connex500 rapid-prototyping system, enabling the manufacture of 3D parts using several different materials. Shapeways also launches as an online 3D-printing service

2009 The first commercial 3D bioprinter, NovoGen, is developed by Organovo. It prints simple tissues like skin, heart muscle patches and blood vessels. MakerBot also ships its first DIY printer kit, the Cupcake CNC

2010 Kor EcoLogic builds Urbee, a car with 3D-printed exterior components

2011 The first 3D-printed aircraft is designed and flown by engineers at the University of Southampton

© Joshua Harker

> The people behind a 3D printer that costs less than €500 EUR to build were the ones that started this revolution
>
> **Samuel Bernier,** industrial designer

The revolution will be printed

Matryoshka dolls are beautifully profound icons of Russian folk art. With the 3D-printed *Mesh Matryoshka* design for Soonsalon, Michiel Cornelissen wanted to add another layer of meaning: how does one doll get inside another?
© Michiel Cornelissen Ontwerp

NEW WORLDS TO PRINT

Like the spread of 3D printers, the adoption of the technology in areas outside of heavy industrial design has been rapid and varied. "3D printing is making a huge difference in product design," says Fernando Sosa, designer and co-founder of 3D-printing and prototyping service nuPROTO (**http://nuproto.com**). "It's revolutionising the way and the speed at which a product can be designed, tested and made available for purchase. Shoe, car and accessory manufacturers are all adopting this technology to speed up their process and reduce costs."

> "[3D printing] is revolutionising the way and the speed at which a product can be designed, tested and made available"
> **Fernando Sosa, co-founder, nuPROTO**

Physical SFX company Artem (**www.artem.com**) bought its first 3D printer in 2006. "It's now an established part of our in-house pipeline," says CEO and SFX supervisor Mike Kelt. "Recent projects incorporating 3D printing include the production of certain parts of the *Halo 4* Master Chief suits we made for Microsoft's launch of the videogame. But other projects range from creative animation characters to action props, such as a retractable knife!"

The fashion industry has long embraced new technology and 3D printing has been used by the likes of Dutch designer Iris van Herpen to create elaborate designs. The most recent Paris Fashion Week was witness to van Herpen's show 'VOLTAGE', featuring two 3D-printed ensembles. These comprised of an elaborate skirt and cape combination that was created with artist, architect, designer and professor Neri Oxman from MIT's Media Lab and printed by Stratasys. An intricate dress was also designed in collaboration with Austrian architect Julia Koerner and 3D-printed by Materialise. The dress used a brand-new and highly elastic material, TPU 92A1.

Of course, smaller wearable items also lend themselves to additive manufacturing. Jewellery projects are very popular for both studio-based self-fabrication and online routes. "Jewellery designer Jo Hayes Ward recently visited us [and] said that without 3D printing she would never have been able to produce her intricate gold and silver pieces," says Paul Armand, 3D print and scanning consultant at Inition (**http://inition.co.uk**)

Using 3D printing with medical projects has almost become the norm, but is no less miraculous for that. In February this year, doctors and engineers in The Netherlands 3D-printed a prosthetic lower jaw from 33 layers of titanium powder. These were heated, fused together and then coated with bioceramic artificial bone. In the same month researchers at Heriot-Watt University, working in tandem with Roslin Cellab, detailed a method for 3D-printing human embryonic stem cells (hESCs).

With the roots of the technology in CAD, architecture is another area where the industry has grown. For instance, an SLS prototype of a house was created last year by Softkill Design (**www.softkilldesign.com**). However, everyday proof-of-concepts can also be brought to life: "We developed a joint project with Zaha Hadid Architects, who supplied us with the real CAD data of the Eli & Edythe Broad Art Museum in Michigan," says Armand. "We used that to produce a 3D-printed model and then brought the building to life, adding to its purpose using augmented-reality views."

Joshua Harker's 3D-printed artwork ready for inspection and delivery to collectors © Joshua Harker

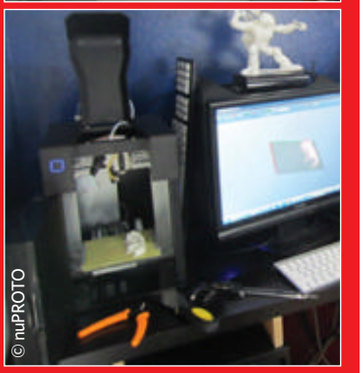
Printing objects with code

London-based Inition's first 3D printer was bought back in 2005. "Since this time we've developed many imaginative ways of using the technology and have expanded our range," says 3D print and scanning consultant Paul Armand. "We've gone from printing parts directly from clients' CAD data, to projects where we're developing code to [effectively] grow 3D-printable objects into a type of physical 3D infographic."

An example of this is *People Wood*, Inition's work with design practice Something & Son. The latter had been commissioned by a Hackney charity to create a sculpture for a new community centre. Inition created a miniature forest of over 400 3D-printed trees, each of which were developed according to data crowd-sourced from online questionnaires. Factors such as the thickness of the trunks and the number of branches represented an individual's sense of community. "It illustrates how 3D printing has emerged from predominantly engineering environments to bespoke creative implementations," observes Armand.

For *People Wood*, a miniature forest of over 400 3D-printed trees were developed using data crowd-sourced from online questionnaires
© Inition

Size matters!



Here you can see the Dimension 1200es Series 3D printer at Artem (top), launched in 2008. In contrast, the UP! Mini printer from PP3DP (bottom) was launched in 2012 for the desktop.

Having an in-house printer has made nuPROTO's production pipeline fast and cheaper. "The *Cyborg Spider* in our gallery can cost about $1,000 US to be printed online," says Fernando Sosa
© Fernando Sosa

Artem used 3D printing for certain parts of the *Halo 4* Master Chief suits made for Microsoft's launch of the videogame
© Artem

ADDITIVE MANUFACTURING FOR EVERYONE

"The reduction of the cost of developing products has brought product design down to the masses," explains Fernando Sosa. "This is why you can see tons of 3D-printed objects [seeking crowdfunding] on Kickstarter and Indiegogo.

"My phone cases with money clips are a perfect example," he continues. "I've sold hundreds of these via Shapeways. I also received much-appreciated feedback to make the design better."

Sculptor and artist Joshua Harker (**www.joshharker.com**) holds the record for the most-funded sculpture project in the history of Kickstarter. "For ten years I owned a design and development studio with very high-end PolyJet 3D printers, a CNC machine shop, a vacuum-/pressure-casting system, a dozen employees and so on," he recalls. "My overheads were [around] $60,000 US per month. I sold my partnership in 2008 and now run at nearly $0.00 US – aside from electricity, workstation and software upgrades. I outsource printing on an as-needed basis, mostly through Shapeways. I keep very little stock and have more time to create rather than produce. Other than having to wait for my pieces to get printed and shipped, it's hard to argue with the benefits."

"Using an external bureau gives you the best all-round choice, as well as leaving the overhead, maintenance and material issues to others," reveals Artem's Mike Kelt. "However, the cost of machines is always lowering and coming within the realms of small-scale users, providing you don't want the latest or most accurate printer. You have to think about the life span of the machine, as upgrading is not really an option. You'd only throw it away and buy a better one after a few years."

Choosing the right printer and material depends on the type of part you want to create. "For complex and organic shapes, EOS has very good powder-based printers, while for affordable and functional objects MakerBots are just great. Also, ABS is strong, flexible and colourful," adds Samuel Bernier. Kelt is also a fan: "ABS is a hard and durable material, which also lends itself to the processes that follow, such as sanding, gluing and painting," he says.

"If you're looking to produce small, less-complex components made in plastic, then a desktop printer could be the most suitable," says Paul Armand. "It's for these types of projects that we would use our 3DTouch printer from 3D Systems. This heats thermoplastic material through the extruder applying layers according to the X and Y co-ordinates. This builds a solid 3D object. It's low-cost and you won't achieve the resolution of professional types of 3D printers, such as powder- or resin-based systems. If you're looking to do rapid prototyping professionally, then the ZPrinter and ProJet 3D printers offer a lot more in terms of colour and high resolution."

The revolution will be printed

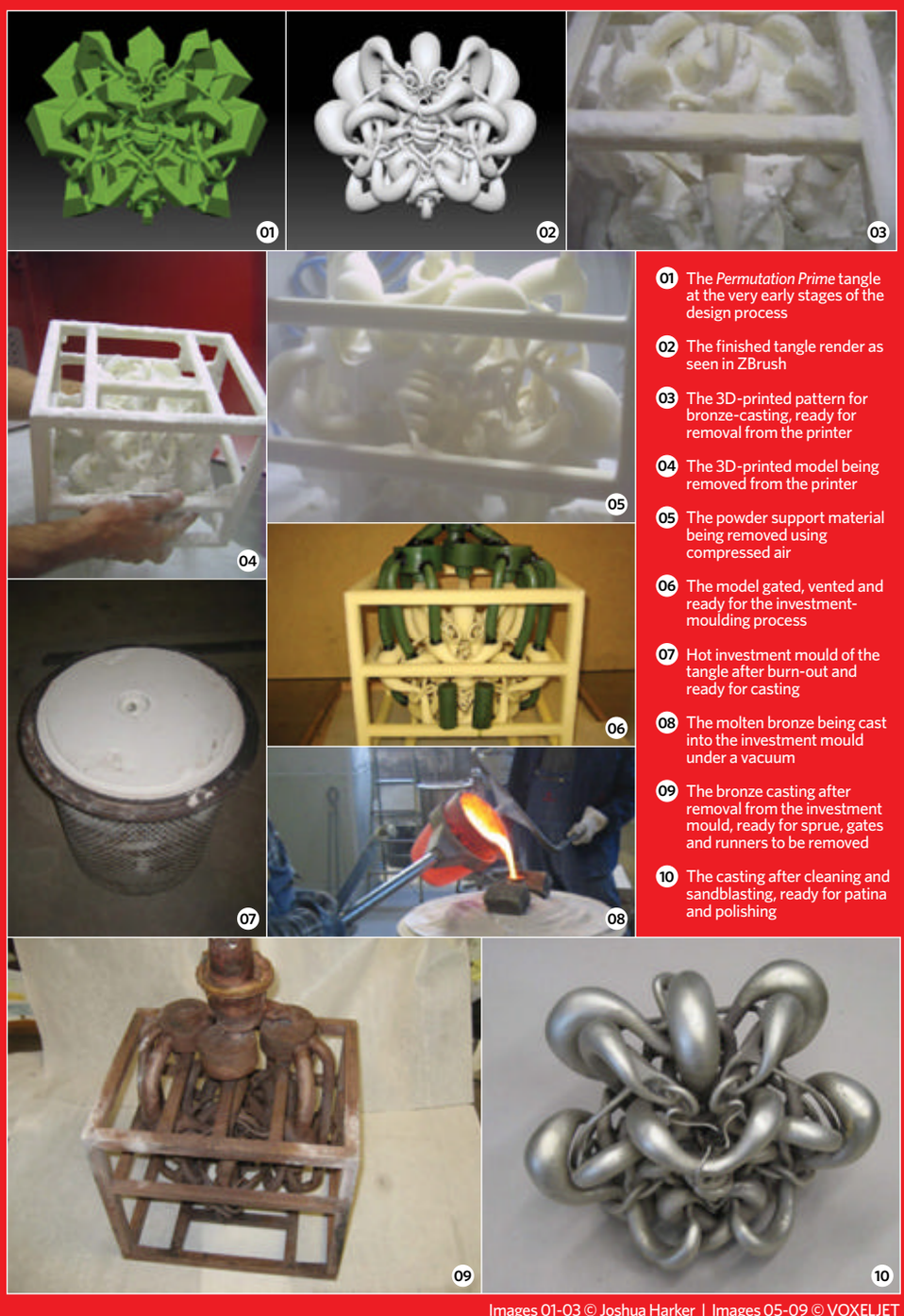
Metallic masterpieces

Joshua Harker's abstract and highly complex series 'Tangle Sculptures' began life in ZBrush, but some of the pieces also ended up in bronze using a 3D-printing process.

"*Permutation Prime* was the very first tangle I made that was printable and *Dynamic Transcendental Migration* was the first tangle that was cast in bronze," says Harker. "Those two pieces tested out the pipeline for creating shapes that were previously impossible. [They were also] the first pieces in history to break the design and manufacturing possibility threshold in their respective materials. This was a perfect storm of software, 3D-printing technology, material engineering and vision."

Here we show the step-by-step process for *Permutation Prime*. More examples can be found at **www.joshharker.com**.

Finished *Permutation Prime* after final patina and polishing
© VOXELJET



01 The *Permutation Prime* tangle at the very early stages of the design process

02 The finished tangle render as seen in ZBrush

03 The 3D-printed pattern for bronze-casting, ready for removal from the printer

04 The 3D-printed model being removed from the printer

05 The powder support material being removed using compressed air

06 The model gated, vented and ready for the investment-moulding process

07 Hot investment mould of the tangle after burn-out and ready for casting

08 The molten bronze being cast into the investment mould under a vacuum

09 The bronze casting after removal from the investment mould, ready for sprue, gates and runners to be removed

10 The casting after cleaning and sandblasting, ready for patina and polishing

Images 01-03 © Joshua Harker | Images 05-09 © VOXELJET

Inition was approached by creative design agency ATYP to provide a 3D scan and 3D print of musician Si Begg's head, for the launch of his new album
© Inition

THE BEST SOFTWARE FOR PRINTING IN 3D

The majority of software packages used in the 3D-printing process output in the industry-standard STL file format. Some more basic tools like Blender, Autodesk 123D and Trimble SketchUp are free, but even with commercial CAD and 3D apps like SolidWorks, Rhino and ZBrush, the process isn't always confined to one application. For example, Artem mostly uses SolidWorks, though ZBrush and Maya are also used in the pipeline.

"I find that Rhino is usually pretty good at creating STLs, especially when I take the time to create a nice clean model," says Michiel Cornelissen (**www.michielcornelissen.com**). For his *Zesch* and *Mesh Matryoshkas* designs Cornelissen also used the generative Rhino plug-in, Grasshopper. "In both cases the model was built up almost entirely in a parametric definition in Grasshopper," explains Cornelissen. "For *Zesch*, it [enabled me to] create the interlocking elements, while at the same time being able to tweak the proportions. For the *Mesh Matryoshkas* design, [the plug-in] helped me make and optimise the mesh pattern interactively, [as well as] play with the proportions of the differently sized dolls and so on."

"I use SolidWorks for hard modelling and pieces that require engineering considerations, whereas ZBrush is best for organic sculptures," says Joshua Harker. "SolidWorks has always been well suited to

Inition's work with Fitzwilliam Museum in Cambridge and Feathercast has shown that 3D printing and scanning can generate much-needed revenue for museums
© Inition

3D printing, but ZBrush not so much – though the experience has become better over the last few years."

"I use SolidWorks, since I come from a technical background," explains Samuel Bernier. "I need my parts to be modified easily by parameters and they often need to be precise. I rarely require organic forms. Also, SolidWorks makes solid parts, which are almost always ready for printing in 3D, while a lot of things can go wrong with surface modelling."

nuPROTO's Fernando Sosa and Mike Bauerlein both have backgrounds in 3D animation, so are most comfortable when modelling in Maya and ZBrush. "However, 3D printing requires a watertight model with non-manifold faces and clean geometry," explains Sosa. "We have used a lot of programs to clean up our geometry and our clients' geometry. In some cases we have used modo to Boolean and clean up geometry. We have also used MeshLab and Blender to check for holes and convert OBJs into STLs – a feature not available in Maya. We've also integrated Magics from Materialise to create watertight shells around complicated objects."

Materialise Magics and NetFabb are STL-correction software packages used to correct inverted normals, fill in the gaps in body meshes, as well as scale, modify and align bodies and parts ready for print.

"Netfabb and MeshLab will help validate and even repair your files in preparation for printing," says Joshua Harker. "There's a limit to what they can do, but they're a good start – and they're free."

> "Rhino is pretty good at creating STLs, especially when I take the time to create a nice clean model"
> **Michiel Cornelissen,** designer

Crooked Cairn detail from Joshua Harker's *Anatomica di Revolutis*, in 3D-printed polyamide
© Joshua Harker

The revolution will be printed

A 3D-printed scale model of The Eli & Edythe Broad Art Museum, designed by Zaha Hadid Architects, was used to showcase new augmented-reality tech
© Inition

Samuel Bernier believes we could soon see printers available for as little as $129 US

> "Printers will inevitably get better, cheaper and faster. The size of machines is limited at present, but I'm sure that will change dramatically"
>
> **Mike Kelt,** Artem CEO and SFX supervisor

THE FABRICATED FUTURE

Given the trajectory the technology has taken so far, there's no doubt that 3D printing is set to accelerate. Paul Armand suggests that we could see different types of desktop printers appearing on the market, other than those based on FDM technology, "such as the Formlabs Form 1 printer", he says. "However, larger printing manufacturers hold a lot of IP for various printing processes and techniques, so it's difficult to speculate what exactly will arrive next. [Certainly], the resolution will continue to be improved, as will the choice of materials and colours."

"Printers will inevitably get better, cheaper and faster," agrees Mike Kelt. "The size of machines is limited at present, but I'm sure that will change dramatically. The materials will advance and no doubt it will be possible to collect parts for certain manufactured items, such as spare car parts, which could be printed locally rather than held in a huge stock warehouse."

Michiel Cornelissen agrees: "Larger products like furniture will become much cheaper to print in 3D, due to the introduction of large, low-resolution printers comparable to what Dirk van der Kooij is using currently (**www.dirkvanderkooij.nl**)." He adds that 3D printers are on the way to becoming a standard household item, comparable to the microwave in the 70s.

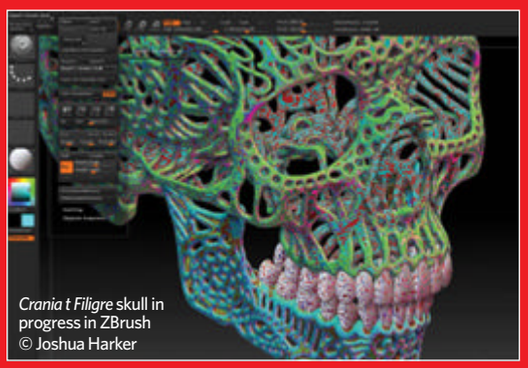
"For FDM printing at least, we can expect 3D printers that cost €100 EUR (around $129 US)," adds Samuel Bernier. "However, I'm not sure that this will be a good thing. I don't think that everybody should own a 3D printer. A lot of people would use it to produce useless junk."

"3D printing might contribute to the throw-away, short-attention-span culture that's already around," agrees Cornelissen. "Need something? Print it, now. Don't like it? Throw it away, print something else..."

This highlights the darker side to this revolution, compounded with a site aiming to host printable gun parts last year. The same party is behind a new site that provides access to blueprints of third-party objects, currently mainly firearms-related. Many of the designers we spoke to were angry at the former and dismissive of the latter, pointing out that Thingiverse already provides a way of sharing designs.

"The good side of all this is that it forces the dialogue and a consideration for what we can ethically do with this technology, [as well as] the ways and means for controlling and protecting IP," observes Joshua Harker.

Harker also feels that the increased adoption of the technology will involve changes to more than just print: "More people will have a measurable percentage of 3D-printed parts in their body, from bony implants to 3D-printed tissues and organs..." he predicts. "Batteries and electronics will be integrally printable into models. Pharmaceuticals may be printed and dispensed from vending machines, using a special prescription card. Capitalism is in line to becoming a better-balanced system, due to the shift from a consumer-centric to a more participatory model."



Crania t Filigre skull in progress in ZBrush
© Joshua Harker

Top tips for printing watertight models

- A file designed to simply be viewed on a 2D medium, such as a monitor, is not up to the task of existing in true 3D. It will be full of holes, where parts don't meet or line up.
- Design from the start with 3D printing in mind. It can take a long time to go back to an existing drawing and attempt to modify it for a 3D printer.
- Always model from solid functions.
- Make sure you don't have a double surface – your model should be like an air bubble, just a skin.
- Solid modelling packages such as SolidWorks and CATIA naturally create cleaner 3D data than surface-modelling packages like Trimble SketchUp.
- Remember, you can't print a plane that has no discernable dimension. Everything has to have volume and cannot have any holes in the mesh.
- You can edit your STL by using a software like Netfabb.
- Perform a very close inspection of the whole model in the software of your choice. Get inside and outside the model, invert it, rotate it and select its faces.

3D Artist would like to thank Joshua Harker, Samuel Bernier, Mike Kelt, Paul Armand and Fernando Sosa for their contributions.

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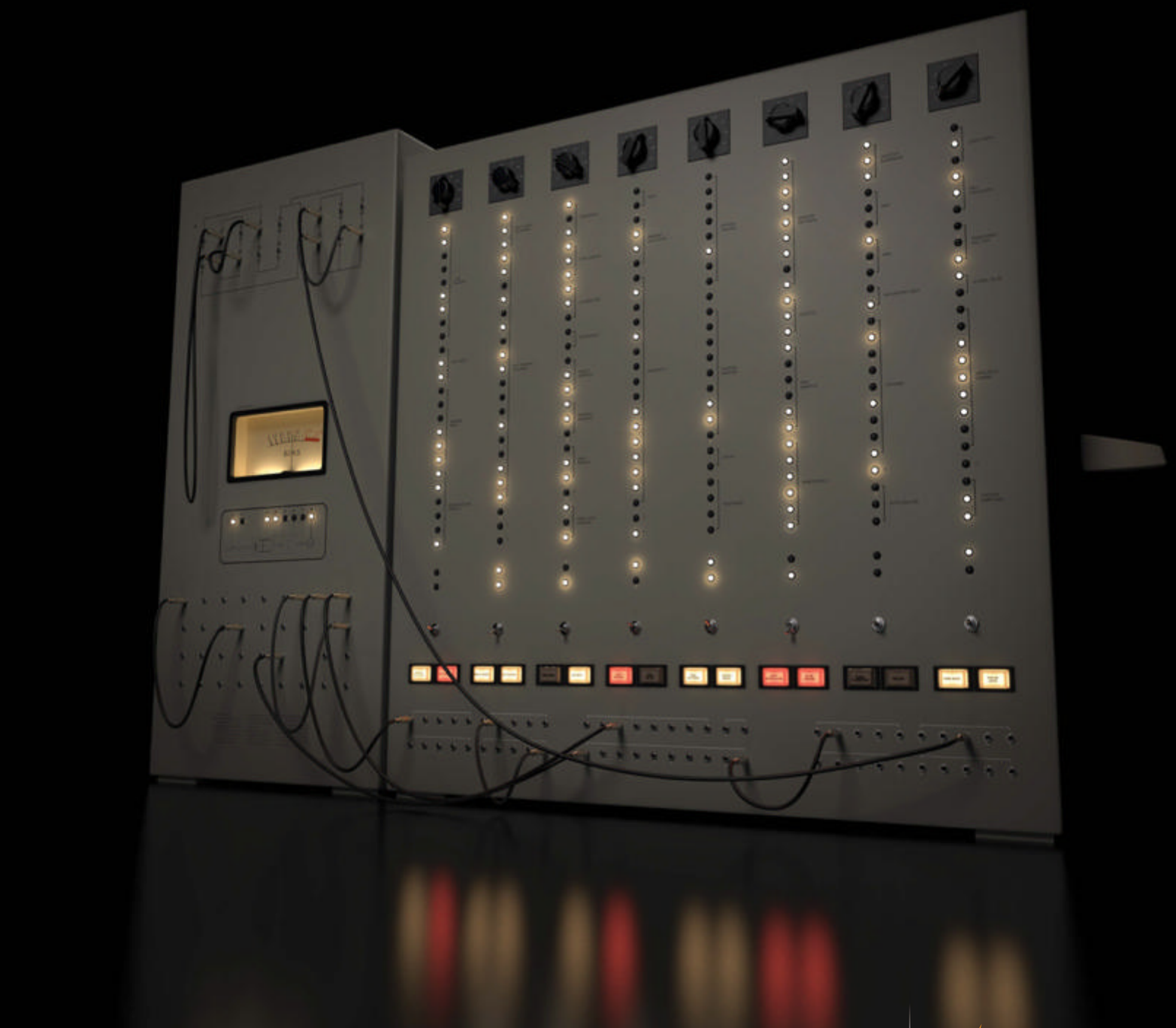

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Digital doubles

> We all know what faces look like, we know how they move and on top of all of that we can tell the difference between thousands and thousands of them with a single glance
>
> **William Bartlett,** VFX supervisor, Framestore

The *Benjamin Button* script had been shopped around Hollywood for years, animation supervisor Steve Preeg says, but "it was deemed to be something that was not possible with the current technology"
© 2008 Paramount Pictures

DIGITAL DOUBLES

Discover how VFX artists are going beyond animation, motion capture – and even death – to conquer the uncanny valley

It's almost no sweat for today's VFX teams to create photoreal landscapes and objects for movie-goers to enjoy. However, the human body – specifically the face – is stubborn. No matter how accurate or detailed, people can still tell a real person from a digital one.

"The human face is probably the most-studied physical object in the world..." says William Bartlett, VFX supervisor at Framestore (**www.framestore.com**). "Most people couldn't describe the literal difference between facial features expressing excitement, flirtation and desire, but virtually everyone can tell you which is which if you show them pictures. We all know what faces look like, we know how they move and on top of all of that we can tell the difference between thousands and thousands of them with a single glance."

Creating a believable digital face is a tall order, but it's something Ed Ulbrich, CEO of Digital Domain (**http://digitaldomain.com**), has been working on for a long time. He's been involved in all the digital human work the company has undertaken, right back to *Titanic* when they created motion-capture doubles for stunts. After that, the team undertook a project for Microsoft founder Paul Allen, known as the Experience Music Project. "Allen created a museum in Seattle with architect Frank Gehry, which was a spectacular space. In that piece we made our first-ever head replacement when we created a young James Brown. That was in around 1998 or 1999."

Motion capture was the dominant technology of the time and though it would be lauded for blockbuster features like *The Polar Express* (2004) and *The Lord of the Rings* trilogy (2001-3), there was a certain leap it couldn't make. Ulbrich comments: "We were still trying to create traditional marker-based motion capture, while playing with different kinds of rendering techniques. It was extraordinarily difficult. If you look back, at the time it was great, but it doesn't compare to what we're doing now. What we mostly learned in these early attempts at re-creating the human face was what *doesn't* work."

The problem, Ulbrich explains, was that "putting dots on people's faces and using traditional marker-based capture is kind of like moving around in a rubber mask. You can get some interesting results, but it's not going to fool anyone. There weren't enough polygons or control points in the fidelity of the data. We needed something that was completely different. [We didn't need to know what] was happening on these points on the face, we wanted to discover what was going on between the points and between the markers".

INTERVIEWEES

Ed Ulbrich
Company: Digital Domain
Location: Los Angeles
Key projects: *The Curious Case of Benjamin Button, TRON: Legacy*

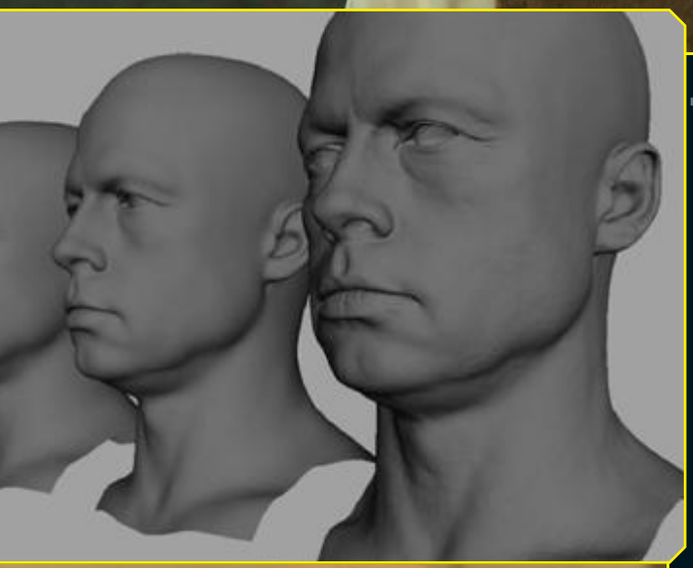
Steve Preeg
Company: Digital Domain
Location: Los Angeles
Key projects: *The Curious Case of Benjamin Button, TRON: Legacy*

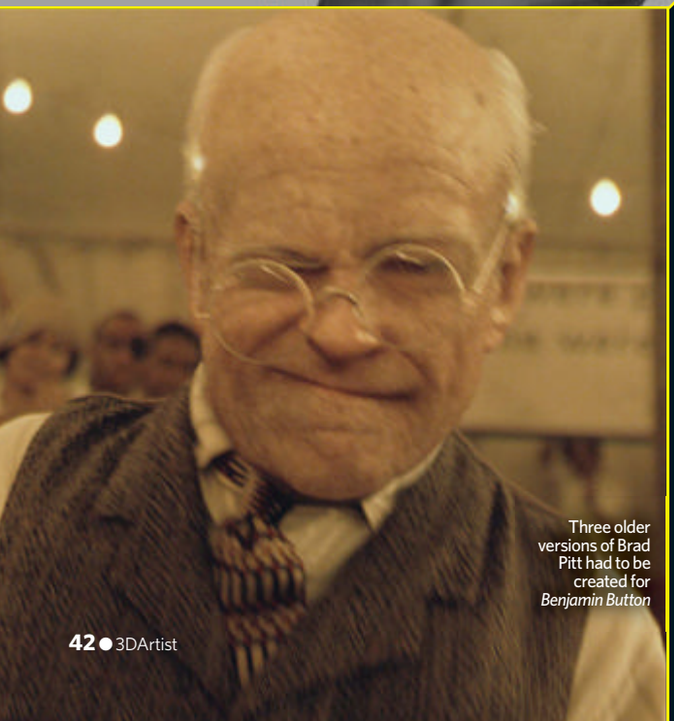
William Bartlett
Company: Framestore
Location: London
Key projects: *Harry Potter and the Prisoner of Askaban*, 'Galaxy Chauffeur'

Digital doubles

Benjamin Button images © 2008 Paramount Pictures

Ulbrich says Digital Domain looks at *Benjamin Button* as its breakthrough moment with the FACS approach: "We had our 'a-ha!' moment and realised that the technique was going to work" | © 2008 Paramount Pictures





Three older versions of Brad Pitt had to be created for *Benjamin Button*

FACS FINDS ITS FEET

When working on *The Curious Case of Benjamin Button*, which required the creation of convincing old-man versions of Brad Pitt, Digital Domain realised state-of-the-art mocap wasn't going to get the right results. "This is where Steve Preeg (animation supervisor) and Eric Barba (VFX supervisor) came in," says Ulbrich. "We started this process of ruling out what we knew wouldn't give us the results that we needed and basically walked away from what it was that everyone else was doing. We had to abandon the status quo, then look at things in a very fresh and different way."

What the team started looking at was the Facial Action Coding System (FACS), which is an index of facial movements, worked on by various anatomists and psychologists, including the pioneering Paul Ekman.

"Ekman believed... that human beings are hard-wired to have involuntary muscle responses in the face as a result of emotional stimuli," explains Ulbrich. "He believed that the hard-wired response to emotional stimuli transcends any age, race, culture, gender and so on. Basically, everybody the world over would respond to the fear stimuli the same way, or anger, or sadness and so on.

"There are subtle combinations, or micro-expressions, where different responses can blend," Ulbrich continues. "Basically the human brain and the muscle responses on the face are hard-wired. You can't bypass that. You can't fake it. If you fake it, you can tell."

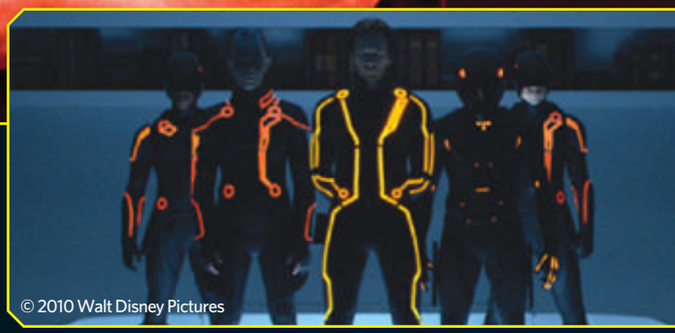
So the team set to work animating this index of emotional responses. There are approximately 70, but "those are just the basic shapes. When you start to create your combinations thereof, it's almost infinite. The range of combinations just goes on and on and on", Ulbrich adds.

The real challenge on *Benjamin Button* was to make three older versions of Brad Pitt – specifically, one at 60, one at 70 and one at 80 – so first the team had to sculpt what he might look like. Ulbrich explains they used some "really famous forensic sculptors who helped age him in a way that was authentic, genuine and quite likely what he would look like". Pitt's performance was captured and that essence-of-Pitt data was combined with the FACS data to animate the sculpted heads. The results were impressive, although Preeg was glad they had some room for manoeuvre, since at least "no one had seen Brad Pitt at 80 years old", Ulbrich adds.

The FACS system is now used all over the world and Framestore has just finished work on the 'Galaxy Chauffeur' advertisement, apparently starring a young Audrey Hepburn™ with it. Bartlett explains further: "There is a prescribed set of basic facial poses that you can perform and capture, then by blending the channels together you can re-create all possible expressions. So, for example, happiness is a combination of the cheek-raiser and the lip-corner-puller, whereas disgust is a combination of the nose-wrinkler, lip-corner-depressor and lower-lip-depressor."

> "The human brain and the muscle responses on the face are hard-wired. You can't bypass that. You can't fake it. If you fake it, you can tell"
>
> **Ed Ulbrich,** CEO, Digital Domain

For *TRON: Legacy*, Jeff Bridges would act the scene with the helmet camera. Then the director would shoot it with all the characters in full costume and a body double mimicking Bridges' actions
© 2010 Walt Disney Pictures



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PUTTING IT ALL TOGETHER

While there was some artistic license in creating an old Brad Pitt, *TRON: Legacy* required Digital Domain to re-create a young Jeff Bridges. This was tough, because unlike Pitt-at-80, Bridges-at-30 was something people *had* seen.

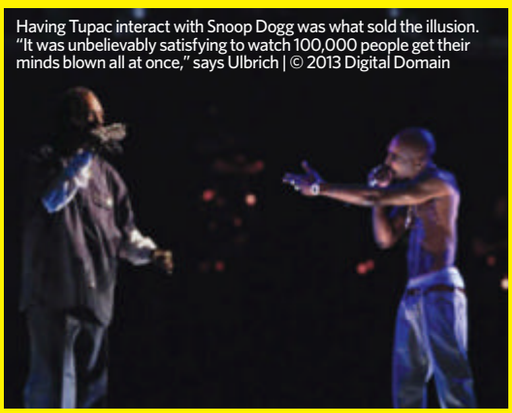
"However, what we found was that everyone has a slightly different recollection of what Jeff Bridges looked like at that age," Preeg comments. "Some people remember him from *Against All Odds* or *Starman*. [Both films are] from around the same time but you have different memories and different feelings of what he looked like." This made the process even more "challenging", Ulbrich adds, "because even if we got it exactly right, people [have a sense of] how he looks now and how he looked five or ten years ago. There's an indelible imprint of what people feel someone looked like as opposed to what they actually looked like."

To help the complex process the Digital Domain team had a wealth of reference material to work from, including films and photos. They also had access to the actor, as Preeg explains: "We could do a light test on him, as well as get measurements of things like where his cheeks sit on his head, how his skin has changed and the shape of his skull. There was also a cast done of Jeff on *Starman*, which Rick Baker's Studio still had from when they were making maquettes, so there was the structure of his younger head there."

Once they knew how Bridges' face moved, they could build a rig for it. After this, the next step was to capture the performance itself. "On *TRON: Legacy*, Jeff would basically act out the scene with the helmet camera and the body double would watch that," Preeg explains. "Then Joe (Kosinski, director) would make a quick selection of which performance he liked best and reshoot it with all the characters in full costume, with that body double mimicking Jeff's actions. There was talk early on of mocapping Jeff on the set, but when we showed Joe tests of the mocap, it definitely had a 60-year-old-man feel, so we canned that pretty quickly."

This was a step up from the process used on *Benjamin Button*, where "for our shots in the first half of the movie, [Pitt] wasn't on the set with the other performers. That was a body performer playing the body of Benjamin and then six months later we captured Brad's performance. He wasn't in the performance with the other actors. We solved this for *TRON: Legacy*, so that Jeff could be there in the moment and we could capture his performance in that scene with those other actors. We'd then apply that to the digital version of him", Ulbrich adds.

Once the performances were captured, attention turned to the facial solver, which "took the dots that were moving around on the face that we recorded and then mapped them onto the digital-effects space", as Preeg puts it. "We needed to figure out those individual dots moving around and what that meant in terms of which models had to be activated for those dots to be in that position and configuration..."

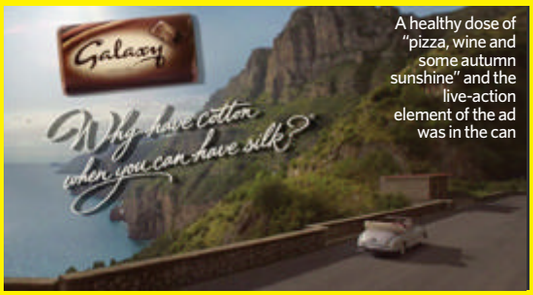


Having Tupac interact with Snoop Dogg was what sold the illusion. "It was unbelievably satisfying to watch 100,000 people get their minds blown all at once," says Ulbrich | © 2013 Digital Domain

BRINGING BACK TUPAC

In 2012 Digital Domain brought controversial rapper Tupac Shakur back to the world of performance, having him appear on-stage at the Coachella Music Festival. Like with Audrey Hepburn™ in the recent 'Galaxy Chaffeur' commercial, Tupac wasn't around to provide reference material. "He died young, [so] there were only a couple of concerts that were even videoed – and they were with low-res video cameras. He was in a couple of movies but he wasn't performing his songs in those, so we couldn't get a reference of [that]," Preeg says. What people referred to as 'the Tupac hologram' was a big hit, with him performing two songs and bantering with Snoop Dogg. But "it's not a hologram", Ulbrich explains. "The technology that was used to project it is actually old. It's called Pepper's Ghost and it's been around for over 100 years. We're just using newer technology to project what is essentially an old stage trick."

Digital doubles



A healthy dose of "pizza, wine and some autumn sunshine" and the live-action element of the ad was in the can

SHOOTING 'GALAXY CHAUFFEUR'

Re-creating Audrey Hepburn™ was only part of the challenge for the team behind the 'Galaxy Chauffeur' ad. They also, of course, had to make sure their digital double would fit into the surroundings they shot. "We wanted to place no restrictions on what director Daniel Kleinman shot to tell the story," says Bartlett. "We knew we would need to be able to render a full-frame HD face."

Both Bartlett and VFX supervisor Simon French were also on the set on the Amalfi coast. Bartlett explains that they shot with "witness cameras to help with the tracking and covered the actress's face with dots, of course. We also shot quite a few stills of other buildings to enhance the architecture in some of the wide shots. The main thing was to ensure that the performance was like her, but that wasn't something that we were solely responsible for. The director and agency creatives were equally focused on capturing a performance that was appropriate".

Audrey Hepburn™ © 2013 Sean Hepburn Ferrer and Luca Dotti. All rights reserved

"In some respects getting the CG face to look like a human being was the easy part," says Bartlett. "Getting it to move like a human being was more difficult and getting it to look and move like such a famous person was even more difficult still"

+ AUDREY HEPBURN™ & THE AWKWARD BITS

Even with all the FACS shapes in the computer and the solver working to the best of its abilities, there are still tweaks that have to be made, things that can only be judged to be working – or not – by the artist.

For the 'Galaxy Chauffeur' ad (**www.framestore.com/work/galaxy-chauffeur**), the Framestore team cast an actress that looked and moved like the real Audrey Hepburn™. Without the original in front of them, they had to depend on their research.

Bartlett explains that the team "only had photographs and stills from films to work from and this gave us something of a moving target, as we had no certain information. We didn't know the lens of any of the cameras and we didn't know how much the stills had been retouched.

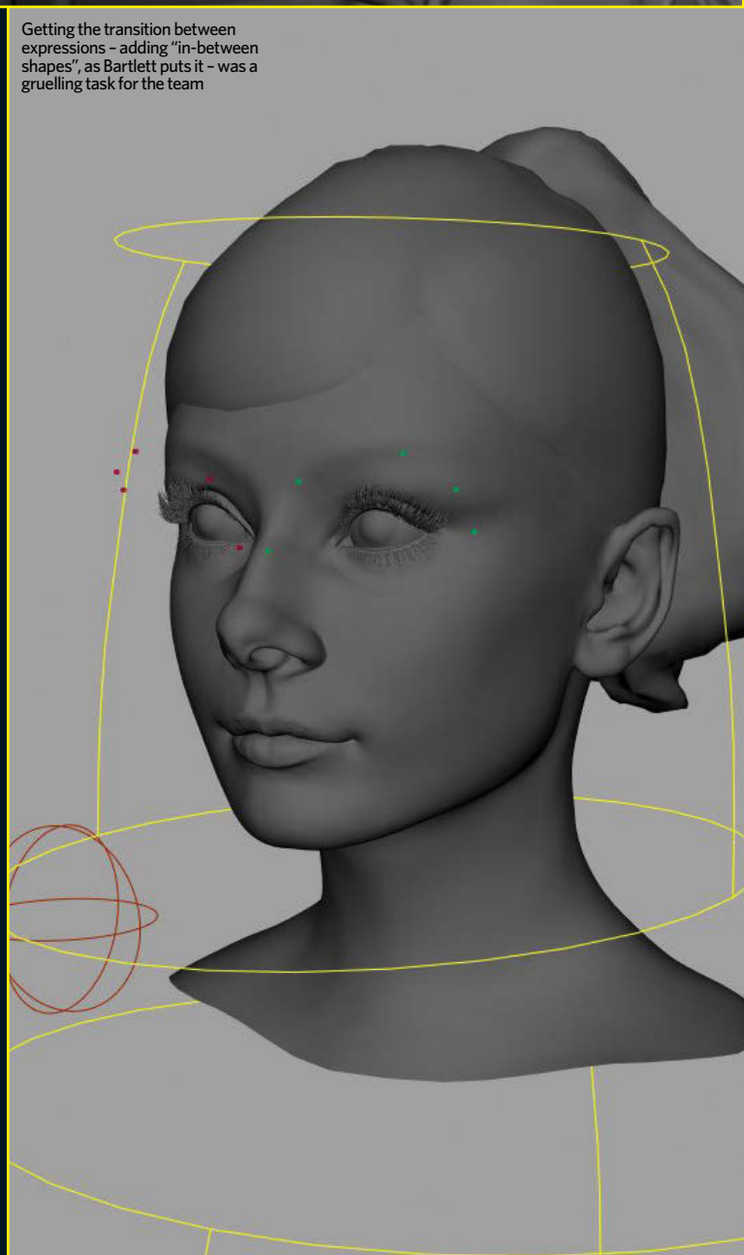
"Nevertheless, we began with about a hundred stills of her that we narrowed down to about ten key ones," Bartlett continues. "We lined up our first model, guessed the camera lens and lit all the shots so we could accurately compare the shapes of shadows, and so on. From there it was an iterative process of making adjustments and then looking at the renders compared to the ten key photographs.

"Gradually, by cross-referencing, we got the base model more and more accurate and by the end it was virtually impossible to tell the difference between the CG versions and the real photographs."

Bartlett continues: "We created CG meshes of all the FACS channels using photogrammetry with the look-a-like actress, and this was our base." However, it was moving between those basic FACS expressions that was the tricky part. "You can have a perfect model in a neutral pose and a perfect wide-mouthed grin, but getting from one to the other isn't easy – just in terms of basic shape-movement, let alone realistic timing," Bartlett explains. "At what point do the lips separate? Do they flatten and stretch across the teeth? At what point do the eyes squint? You can't just translate from one shape to the other in a linear way. You have to add in-between shapes that all need to be sculpted."

Preeg agrees that it's still the human touch that makes the results look more realistic. He explains that the solver is a machine, so "the difficult part is when you put that data through, render it and you say 'I'm not getting the same feeling out of the person that I feel when I look at the video footage of that person'. That's when you have to look at it and ask yourself: What is it that's bringing out the emotion in that character? It could be the tiniest little thing in their eyelid movement, or how wet their eyes are. [We don't actually capture] the eyelids themselves, so it could be some very tiny thing – and it tends to be somewhere around the eye area – that's missing."

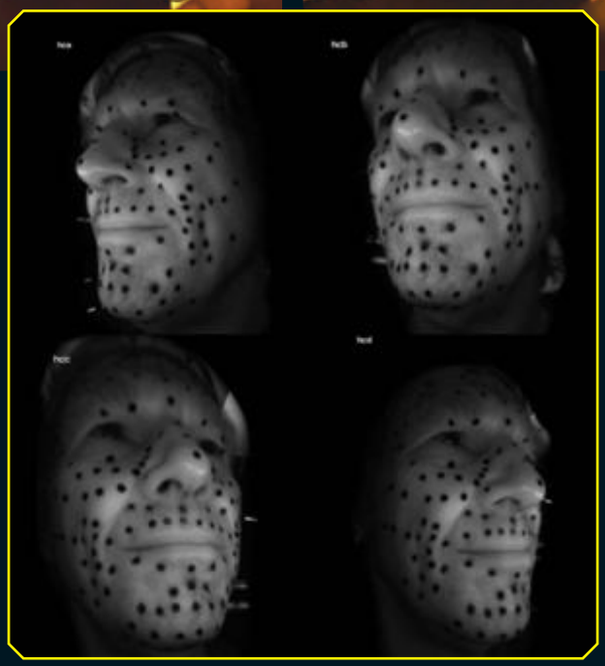
It all comes back to studying the footage and noticing the smallest details. Preeg notes that Brad Pitt, for instance, smiles with his right-side lip corner just ever so slightly higher than his left, so a digital version of him that didn't do this would look ever so slightly off. This may not even be noticeable at first, but it makes all the difference.



Getting the transition between expressions – adding "in-between shapes", as Bartlett puts it – was a gruelling task for the team

© 2010 Walt Disney Pictures

"For the amount of time we spent on the rigs, the majority of [it] was on the eyes," Preeg explains



Preeg believes that "the ego of the human" is part of the reason audiences spot when a digital double has been used | © 2010 Walt Disney Pictures

> "Every time we start a project that has this, I cringe. When I wrap projects like this, I'll tell myself I'm never going to do another project with digital characters again"
>
> **Steve Preeg, animation supervisor, Digital Domain**

THE END FOR ACTORS?

No matter how good the digital double we see in *Benjamin Button*, *TRON: Legacy* or 'Galaxy Chauffeur' is, the audience is still aware of differences. Preeg thinks that part of this is "the ego of the human. If you know that it's not real you will immediately start coming up with reasons why it doesn't look real. That's one of the reasons David Fincher was very adamant that we couldn't tell anyone that we had [worked] on *Benjamin Button* until after the movie was out". He believes that the next step for the future is "us figuring out exactly what it is that's causing that last little bit of unbelievability".

For Bartlett, "a lot of the uncanny valley effect is to do with detail and complexity. Creating a real-looking head and face is now well within the capabilities of technology. The challenge is really in bringing the models to life in a convincing way. More than anything else that we learnt is that the human face moves in an incredibly detailed and subtle way.

"For example, when you smile, all sorts of other parts of your face need to move as well as your mouth for it to look real," Bartlett continues. "Your cheeks rise, your eyes squint, your brows flex and even your ears often rise. Tiny changes in these secondary movements have a huge impact on the reality of the movement and also the recognisability of the person. We all do these things in slightly different ways. Our faces are very asymmetrical, both in terms of shape and animation, so they keep moving a lot of the time, if only to a tiny degree. It's working on these details and nuances that I think helps move a CG face out of the uncanny valley and into reality".

However, even if they wanted to, VFX teams aren't about to boot the actors out of Hollywood. "You still need a performance from somewhere," says Preeg. "A computer isn't going to generate a performance and if you leave it up to a team of animators you're going to have inconsistency. It's going to be way harder to come up with a character with a compelling character arc if you leave it up to 40 animators, rather than hiring one good actor and basing it on that..."

"After all, the reason we bother to re-create Audrey Hepburn™ is that great stars are capable of creating movie magic, and that isn't going to change," Ulbrich says. "There are things that happen in the moment between actors on a set and it's magic. Sometimes you can't write it, it just happens. That's the stuff; that's the great cinematic magic... that captures the minds of the world... I don't see this technology ever replacing actors. I think it's giving them the opportunity to extend their performances... *Avatar* was just the beginning. This is going to explode. It's going to take things in a whole new direction."

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This character has seen his fair share of death and war. His stance and expression suggest that he probably doesn't know (or care for) fear
His gaze is unflinching. His expression is a mixture of disdain for his captors and determination to escape
His features are grimy and weather-beaten, a testament to his hard life. There is barely a square-inch of skin unblemished, while a dent on his nose is significant of a past injury
From the thickness of his neck and the slope of his shoulders, we can see he is powerfully built. The metal collar barely fits around his neck
He sports a single gold tooth in the centre of his bottom row

Character concepts

Prisoner 2013

"The concept is a tough mercenary who remains defiant. His steely gaze and battle scars suggest he's not ready to give up just yet!"

Simon Dominic is a freelance digital illustrator based in the UK

A The concept sheet gives the 3D artist a front-on, side and three-quarter view

B Thumbnail sketches are helpful while exploring ideas for character designs

Artist info

Simon Dominic

Personal portfolio site www.painterly.co.uk

Country UK

Software used Painter

Expertise After seven years of creating art as a hobby, Simon Dominic turned pro in 2010. He now works mainly on illustrations for social gaming and creating art for card games.

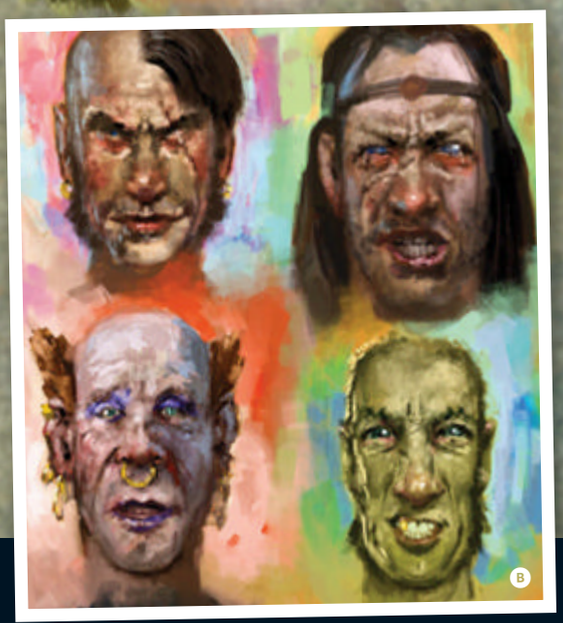
His jaw is powerful and his jutting chin emphasises the strength of his will

A deep scar runs from his forehead down to his left cheek. The injury has left him blind in one eye and this contrasts strongly with his undamaged right eye, which is a striking blue. The scar isn't recent and has clearly occurred in battle

As an extra feature, his prisoner number has been cut into his shaven head. Once safely in his cell he is not expected to leave, though he may have other ideas...

A rusting metal collar is secured around his neck with a thick chain. The simplicity of the collar signifies that he is being kept in Spartan conditions

A



B

The goal here was to produce concept art for a 3D artist to replicate into a convincing character bust. When creating concept work for 3D artists you need to ensure there is enough information captured in the design to help them interpret materials, textures, expression and so on.

To present a challenging project for the 3D artist (see how Adam Fisher tackles it on the following pages), I've included scarring, facial hair, shaved details in the hairline and lots of aging. The expression is of key importance here, as it makes the character engaging for the audience.

The final result shown on these pages is a rugged male character portrait – a strong and charismatic fellow that has been through the wars. To get to the final design, thumbnails were helpful to explore different ideas. Reference images from the likes of Dreamstime.com also helped to achieve realism in the expression and skin imperfections.

The concept sheet supplied to the 3D artist provided him with a front-on, side and three-quarter view to give him as much 3D information as possible to tackle the project. You can see the results and follow along on the next pages.

Step by step

Easy-to-follow guides take you from concept to the final render

Artist info

Adam Fisher

Personal portfolio site www.afisher.com.au
Country Australia
Software used ZBrush 4R5
Expertise 3D character art for the videogame industry

Incredible portraits

The Prisoner 2013

"Follow this ZBrush workflow to create a 3D interpretation of a stylised character concept"

Adam Fisher works as a 3D artist for the videogame and simulation industries

Taking Simon Dominic's concept of this menacing convict (see previous pages), I'll be taking you through my workflow for creating a character bust. We'll go over the whole process, from sculpting the main forms to refining the model with pore and wrinkle details. We'll be using DynaMesh to create the clothing and the chain, FiberMesh to add facial hair and we'll also go over some Polypainting techniques to bring the character to life.

ZBrush is the tool of choice for this process because it gives us the freedom to create without the need to jump between multiple software packages or worry about technical limitations. Once our character has been sculpted and Polypainted, we'll pose him and render multiple passes to be composited in Photoshop.

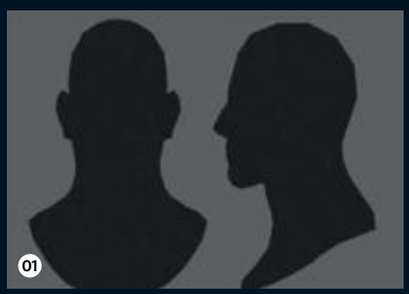
Control subdivision

When starting a sculpt it's important to keep the subdivision level low, especially when blocking in proportions and main shapes. You can then slowly subdivide (Cmd/Ctrl+D) to add polygon density as needed. Doing this helps prevent your sculpts from looking bloated and gives you more control over your mesh. If you are working on a higher subdivision level and need to make large changes to the mesh, drop down to a lower subdivision level (Shift+D) to enable smoother transitions and easier control.

Establish initial form

Block in the basic shapes of the character

01 Build the base mesh With the DynaMesh tools in ZBrush it doesn't really matter if you're starting with a sphere or a pre-existing base mesh. The main thing is to keep the subdivision low at this point. I like to keep my brush size large and avoid zooming in on the character early on. This way I'm only concentrating on the overall silhouette of the character. To start we'll concentrate on getting the main shapes and proportions of the head, neck and shoulders. Hitting Y will toggle between the default white and black of the SubTool, enabling us to check the silhouette easier.



02 Work out the major forms I like to exclusively use the Move brush early on to manipulate the major shapes into place. Looking at the concept we'll try to establish where the eyes, nose and mouth sit in relation to one another. At this point we can begin to subdivide and, using the ClayTubes brush, block in the major forms and structure. Using the DamStandard brush we can also cut in some guidelines for skin folds and concave shapes, such as the nasolabial fold, philtrum, eyelids, brow and lips.

03 Add eyes & teeth For the eyes, click on Append in the SubTool palette and choose Sphere3D. Using Deformation>Size, scale down the eye to fit the character's head. Then, using Transpose Move, we can position the eye in place. To create the other eye, simply use ZPlugin>SubTool Master>Mirror and choose Merge Into One SubTool. Once the eyes are in place, make adjustments to the eyelids to fit the curve of the eye. For the teeth we can append a Cube3D and resize it using the Transpose tools. Under Geometry>DynaMesh, set the Resolution to a low amount (such as 128) and create a U shape for the gums and teeth. Turn off DynaMesh, increase the subdivision, then block in the teeth and gums using the Clay brush. Slowly refine the teeth with the DamStandard and Standard brush while increasing the subdivision level.

01 Having the SubTool black is easier to quickly visualise and check the silhouette

02 Concentrate on establishing the forms before starting on the details

03 Once the teeth are sculpted, adjust their position within the character's mouth

With the Disc

Tutorial file:

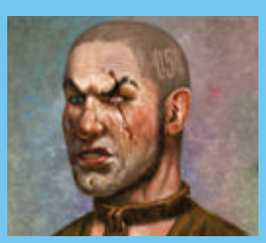
- 'Prisoner_Polypaint_Timelapse.mp4'

Learn how to

- ☑ Sculpt a character bust based on a concept
- ☑ Use DynaMesh to create clothing and accessories
- ☑ Use FiberMesh to add facial hair to your characters
- ☑ Polypaint your character using ZBrush
- ☑ Pose a character with the Transpose Master tool
- ☑ Render a character in ZBrush

Concept

We're going to be making an interpretation of Simon Dominic's concept. The character has some strong features that we'll focus on, like his jaw, brows and substantial scars.

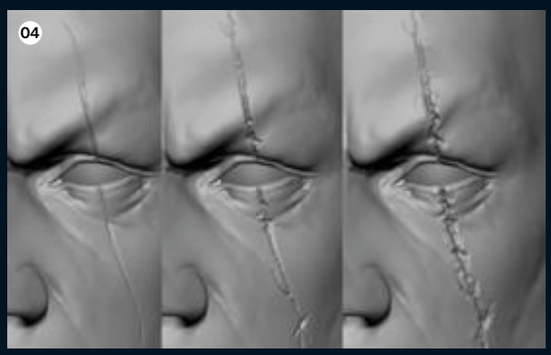


Make refinements

Create clothing & add details

04 Sculpt the scars In the concept this guy has some pretty gruesome scars. The one over his left eye and upper lip are indented, so we'll start by using the DamStandard brush to create the initial line and flow of the scar. Next we'll go back over the line and include some irregularities, then by using small strokes and the ClayTubes brush we can build up the scar tissue around the edges. The ClayTubes brush is great for these kinds of details and we'll use it again for the small raised scars on his head, by blocking in the rough flow and shape of the scar. To add some more irregularities we'll set the Intensity a little lower. Using short strokes that alternate between Zadd and Zsub (holding Opt/Alt) we can build up the grisly scar texture.

05 It's all in the eyes I like to apply some Polypaint to the eyes before I finish the sculpting phase, to bring some life into the character as I'm working on it. The MatCap I'll be using is the zbro_EyeReflection and can be downloaded from **http://luckilytip.blogspot.com.au**. Select a base off-white tone and, with MRGB turned on, go to Color>Fill Object. Next, choose the Standard brush, turn off Zadd and only have RGB turned on. We'll select a brush size that fits the size of the iris and paint the darkest outer-edge of the eye. Next we'll choose a lighter saturated tone and paint in the iris, giving a slight taper to the lower half. This enhances a concave effect around the iris. Add some lighter flecks to the iris, then include a black pupil as well as some subtle veins and colour variation to the sclera. To finish this element, we'll paint in some fake occlusion to give the eyes some grounding in their sockets.

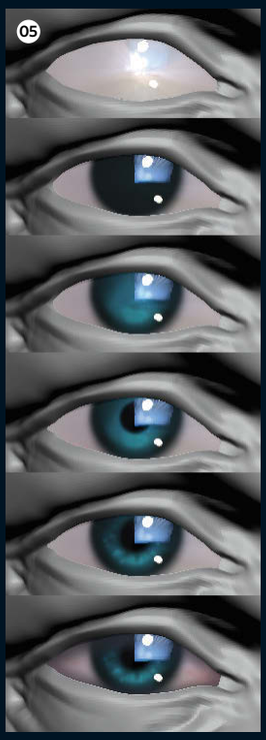


04 Use DamStandard and ClayTubes to create the scar

05 Polypainting the eye with the Standard brush

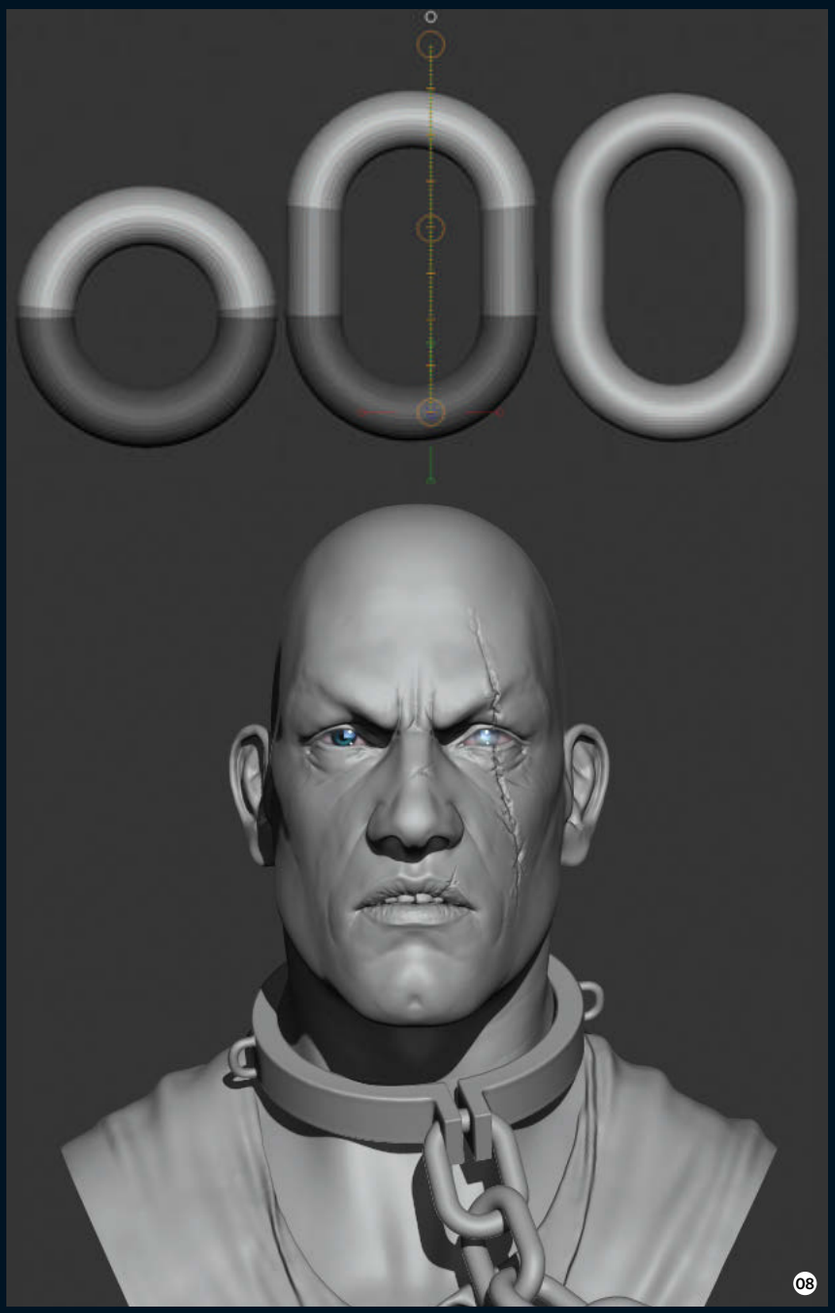
06 Use masking to pull out the overlapping shapes

07 Position the SubTools then use DynaMesh to merge and subtract the shapes



06 Create the shirt To clothe our character we'll begin by appending a sphere and resizing it to roughly fit. With the DynaMesh resolution low, we can use the Move brush to block in the basic shape of the shirt. We can then begin to subdivide the mesh and build up details. For the collar area of the shirt, we can mask the areas where we want to create the appearance of an overlap and use the Move brush to pull these areas up and over. Use the DamStandard and Standard brushes to refine the details.

07 Build the chain collar To shape the chain collar we're going to use DynaMesh to subtract and merge different meshes. Subtract one cylinder from another to create the neck opening, then merge a cube and subtract another cube to produce the area where the chain links in. To subtract one mesh from another in ZBrush, go to the SubTool palette, move to DynaMesh (A) above the SubTool (B) you are going to use to subtract. The lower SubTool (B) needs to have the Difference SubTool icon selected, which is the second icon. Select the top SubTool (A) and go to SubTool>Merge>MergeDown to combine both SubTools. To create the subtraction, hold down Cmd/Ctrl, then click and drag on the canvas to re-DynaMesh.



Morph Targets & layers

The use of Morph Targets and layers can be extremely beneficial to non-destructively add detail. For example, you can store a Morph Target then start to sculpt scars and if you aren't happy with a particular area, use the Morph brush to paint back to the stored version of the sculpt. Layers can be helpful for controlling tiny details like pores. By placing the pore details on their own layer, you can increase or decrease the amount that they're visible, giving you greater control over them.

08 Add the chain links For the chains we'll need to append a Ring3D. Go to Deformation>Inflat to add some thickness. By masking half of the ring we can use the Transpose Move tool to drag half of the ring upwards to extend the middle area. Next we'll use DynaMesh to reconstruct the topology. With the first link created we can now duplicate and position a few more links using the Transpose tools. This enables us to add a sense of movement to the character.

09 Detail the accessories We can now do a cleanup pass over our accessories and apply some more detail. For instance, we'll want to add some wear and tear to the chain links. To do this we can use the Mallet Fast brush which can be found in Lightbox>Brush>Mallet>Mallet Fast.ZBP. Just use small strokes to add some dents and scratches to the collar and chains. We can add some seams to the shirt using masking with the Move and DamStandard brushes, then also add some more folds to the shirt using the Standard brush.

10 Focus on the face With the sculpting phase almost complete, it's now time to add some finer features. DamStandard is the main brush I use for applying wrinkles and the smaller details. For the pores and stubble texture, I use the Standard brush with a pore Alpha and the Stroke set to Spray with a low Intensity. Try to keep in mind places like the nose, which tend to have larger and more visible pores. You can also use a mask for areas like the lips, where you don't want any pore detail.

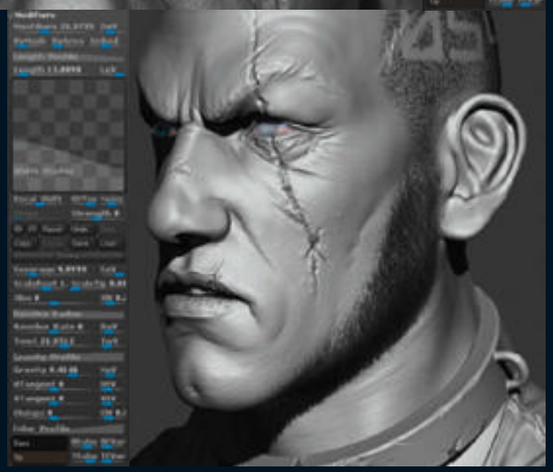
08 Create the chain links and position them using the Transform tools

09 Add a mask, use the Move brush to define the seam, then Standard and DamStandard to refine

10 Use a pore Alpha with the Stroke set to Spray to achieve the pore details

FiberMesh & Polypainting

Apply the texture & build the hair



11 Apply & adjust the hair FiberMesh works by applying hair strands to any masked area of a SubTool. To create the head stubble, we'll first need to create a 054 black-and-white image in Photoshop to be used as a mask. We can then mask the area of the head we want to add hair to and subtract the 054 shape using the created Alpha. Click the Preview button under the FiberMesh palette. Under Modifiers, change Length to 10 and Coverage to roughly 70. Change the Width Profile to create thinner strands and the Base and Tip colours should be a dark brown. Use the BPR Render (Shift+R) to test what this looks like. Once you're happy with the results, go to FiberMesh>Accept.

12 Shape sideburns & eyebrows Mask the sideburns area and select Lightbox>Fibers under the FiberMesh menu. This will provide some presets to choose from and edit. For the sideburns we can use the Fibers196 preset. Set Length to 14, Coverage to 10 and adjust the Width Profile. Turn the texture off and set the Base and Tip Color to brown again. Click Accept and then mask the area for the eyebrows. This time we'll use the Fiber160 preset and change Length to 110, Coverage to 2.25 and Gravity to -0.5. We'll also need to adjust the Width Profile, and change the Twist and Revolve to approximately 135. Select dark brown for the colours and render to test the hair. When happy with the results click Accept. Now we can use the Groom brushes to style the eyebrows a bit more and really get them looking rugged.

11 Mask the head and apply the FiberMesh options to fully build up the hair

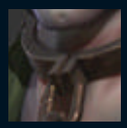
12 Edit FiberMesh presets to create the sideburns and rugged eyebrows

13 Layer on the colours and tones for the most-effective skin tone

Masking tips

There are some masking tools in ZBrush that can be used to help speed up the workflow and create some interesting effects. Masking>Mask PeaksAndValleys can be used to quickly create versatile patterns for texturing. In this case it was used for Polypainting the chain. Masking>Mask By Smoothness is also very useful for quickly painting edges and dents, especially when working on hard surfaces. Play around with the sliders to see what you can come up with.

13 Begin Polypainting For the skin I like to use the zbro_Viewport_Skin2 MatCap, which can be downloaded from **http://luckilytip.blogspot.com.au**. To begin painting the skin, fill the SubTool with a neutral skin tone as the base colour. Using a Standard brush, with just RGB on and a blue selected, block in the beard area and around the eyes. Add some red around the nose, lips and cheeks, then a yellow tone on the forehead and slightly on the cheeks. Using these more-saturated colours will give us some nice variation and a good foundation to work from. We can then begin to build up on the darker and lighter skin tones and use a pore Alpha with the Stroke set to Spray to add some more texture to the skin. Now we can slowly build up and refine the textures and values.



Finalise the sculpt

Add the last touches to bring out real personality

14 Final posing To finish we'll need to add asymmetry and pose the character. This can be done with ZPlugin>Transpose Master>TPoseMesh. Then, using masking and the Transpose tools, we can position the character into an interesting position. In this case I've tried to achieve a pose that would fit the concept artist's description of this character. When this is done, go to Transpose Master>TPose-SubT to transfer the pose back to the SubTools. We can now tweak the mean expression.

15

15 Set up the render When the sculpt is finished and ready to be rendered, we'll need to find a nice camera angle and store its position in Document>ZAppLink Properties>Cust1. For the lighting setup I like to use one main light from the front and two rim lights from behind. We'll render these out separately to be composited together in Photoshop. To create a rim light, simply click on the dot in the Light Placement Preview window in the Light palette. This will send the light source behind the character. When rendering the rim lights, turn off Polypaint for each SubTool and use the Basic material. I also set my colour to black.

14

16 Make render passes Once the lighting is set up, we can begin to render out the different passes. The starting render passes I use are the main BPR Render, Shadow, the Rim Lighting passes, Ambient Occlusion and Depth. The next passes I render are the Cavity, using the SketchShade2 MatCap; a Specular pass, using the Basic material and the Color set to black; then finally a Reflection pass for the chains, using a combination of the Reflected Map and Chrome materials.

16

17

17 Unify the bust Once we've rendered out our passes it's time to put everything together. I like to experiment with the different layer blending modes in Photoshop to see which effects I can find. In this case my Ambient Occlusion, Cavity and Shadow passes are all set to Multiply with the layer opacity lowered. For the Rim Lighting, Reflection and Specular passes I've ended up using a combination of Color Dodge and Screen. Once you're happy with how the image is looking, you can make a final Levels and colour correction to really make the image pop.

14 Use Transpose Master to pose the character

15 Set up the main and rim lights

16 The ZBrush render passes

17 Compositing all of the render passes together

Experimenting with MatCaps

Don't be afraid to experiment with layering different MatCaps in your render passes. You can also edit existing MatCaps to suit the material you're trying to render. Trying out different MatCaps and blend modes can lead to some interesting effects and an overall more engaging render.

• **DID YOU KNOW?** • All tutorial files can also be downloaded from: **www.3dartistonline.com/files**

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Create 3D game assets

Spacegirl 2013

> Combining different materials and approaches to modelling, we'll make this character seem less streamlined and more authentic

Gavin Goulden is the lead character artist on *BioShock Infinite* and has contributed art assets to numerous titles such as *Dead Rising 2*, *The BIGS 2*, *F.E.A.R. 2* and *Damnation*.

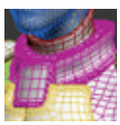
Here you'll learn all the necessary steps towards completing this hero character for a modern-day videogame. Over the next few pages I will share the key aspects of my everyday workflow, covering what makes a quality low-resolution model, as well as topology and mesh rules. You'll learn how to properly lay out your UV map for the best texel density, as well as how to produce the different textures involved to build a material, using both Specular and Diffuse maps where necessary. We'll start with a basic rig, using 3ds Max's Biped system, then finally establish a pose that's ready for a successful videogame artist's portfolio.

Step by step
Easy-to-follow guides take you from concept to the final render

Artist info

Gavin Goulden

Personal portfolio site www.gavimage.com
Country USA
Software used 3ds Max, Photoshop, CrazyBump, xNormal
Expertise Gavin's main focus is on character art (modelling, texturing and rigging) for games on modern platforms



Start the low-poly model

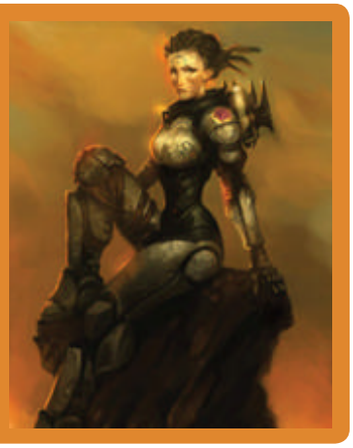
Shape a character model ready for further development

01 Use a high-res model as the guide

The first step I take when modelling a low-res character is to import a crunched-down version of a high-res one. Usually this means a model from ZBrush with reduced subdivision levels, but it could also involve decimated or collapsed models from 3ds Max. This serves as a guide to model over and doesn't require a ton of detail – essentially just mid- to low-frequency details – so the silhouette stays the same. Part of this process will also require picking details that can bake down easily. These can include bolts, stitches, laces and other smaller extras. Follow along with the tutorial files supplied.

Concept

This concept from Jorge Lacera (http://lacera.blogspot.co.uk) is great for showing the colour palette and material variations that will define the asset. You can follow his approach to concept creation in issue 53 of **3D Artist** magazine (pages 52-53).



01 Importing a reduced high-resolution model is a great starting point

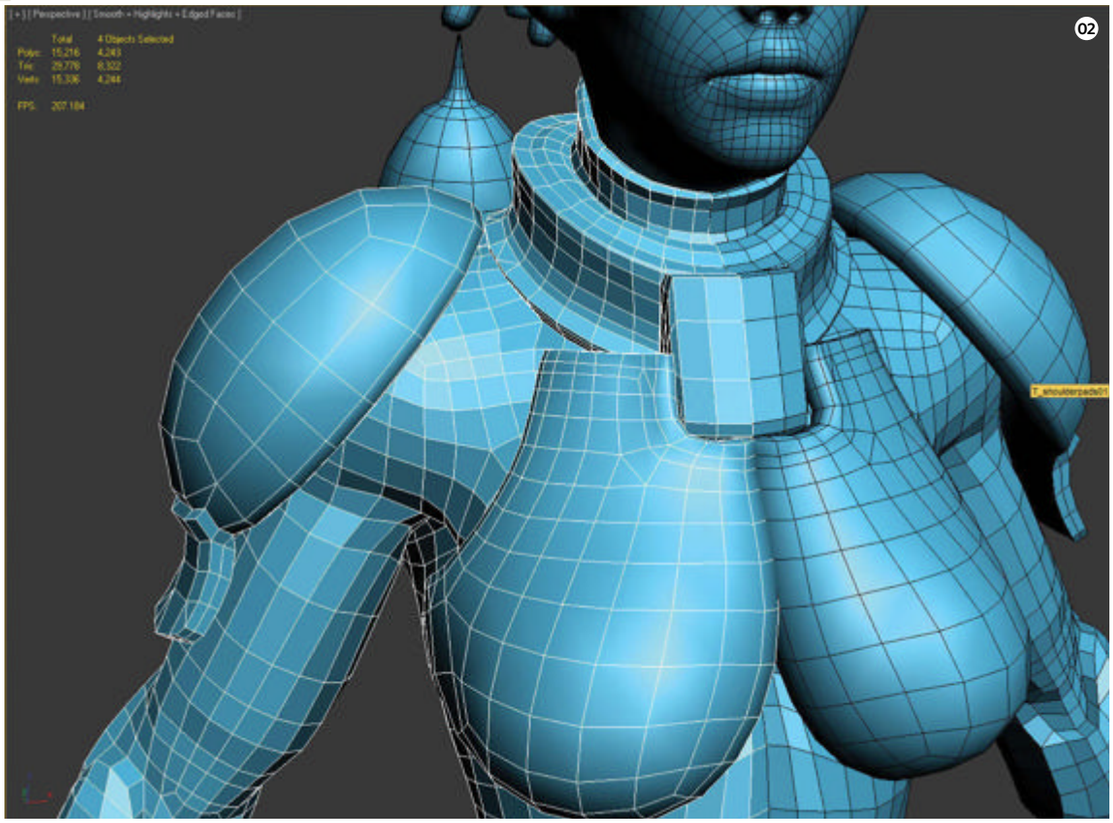
Learn how to

- ☑ Create a low-poly model ready for the very latest videogame hardware
- ☑ Properly unwrap a character
- ☑ Build Diffuse, Normal, Specular and Emissive textures for your model
- ☑ Rig a character using a premade skeleton

With the Disc

Tutorial files:

- High-poly model
- Rigged and posed versions of the low-poly model
- Texture maps

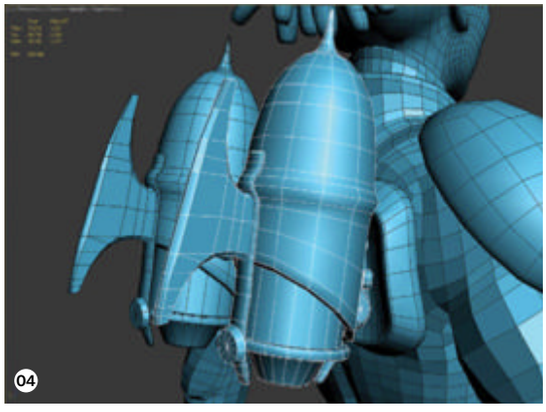


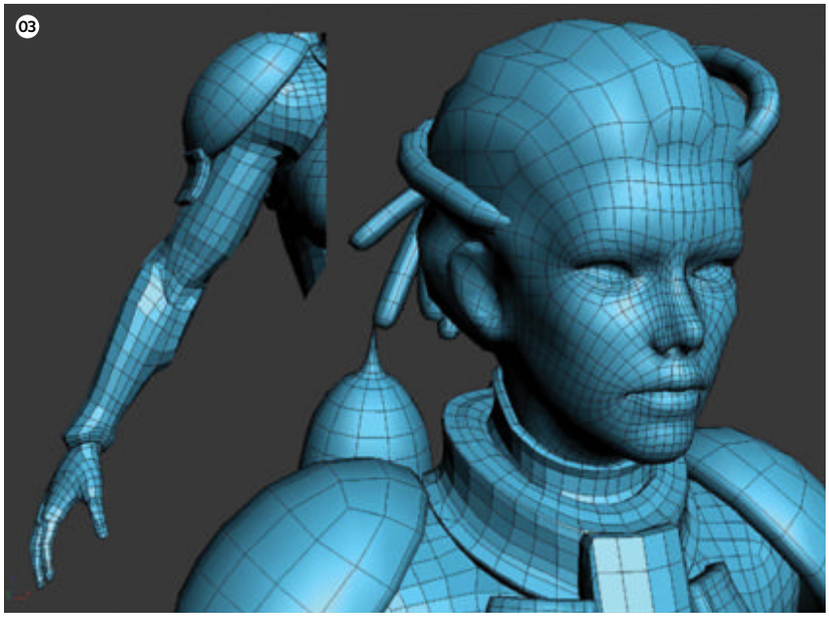
Make every edge count

Unlike base meshes for sculpting, consistent mesh density isn't as big an issue. Here a mesh will be heavier in focal areas or places that need to deform, like the face and hands. When creating a videogame character – or really any asset for a modern game – the key thing to keep in mind is that every edge serves a purpose. The edge will be used for proper shading with Normal maps applied, or for smooth deformations during animations – either by directly being a major edge loop around a joint, or a supporting edge for twisting. This way of thinking should help you keep an asset within budget and make reducing a model or designating edges far more straightforward.

02 Model with Edge Extrusion I usually follow the Edge Extrusion method of modelling, meaning I shape a polygonal grid, grab an edge, duplicate it and adjust it to follow the lines of motion I want in the topology. In the initial stages I try to find a symmetrical point to speed this process up. Here the majority of the character is symmetrical, save for a few bold areas that need to be modelled as unique elements. Starting with a reduced version of my model, I split it in half by removing all the faces on the right side of the X axis. Then, with the model selected, I click the Mirror icon towards the top of the screen and create an Instance mirrored on the X axis.

03 Use topology for deformation Always consider the flow of your edge loops when modelling. Key areas, like the knees, elbows, knuckles and mouth, generally require at least two or three loops for proper deformation. This basically means a loop devoted to each bone at a major joint, with one in between for blending. Usually the more geometry included, the better, but you should always consider budgets.





04 Apply geometry to support Normal maps Another aspect to focus on when building your model is whether or not you have enough geometry to support an effective Normal-map bake. The best example to give, without destroying your model's budget, is to consider keeping all your round or cylindrical objects as round as possible. As simple as this may sound, many artists mistakenly try to bake a perfectly round bolt down to a five-sided cylinder, for instance. Though this may solve any potential budget problems on the production, the result of your bakes will be warped. This is because too few vertices would be trying to sell the illusion of a complex shape.

02 Mirroring a model can save a ton of time when creating a low-resolution asset

03 By using the Edge Extrusion method, you can easily control the flow of your model's topology

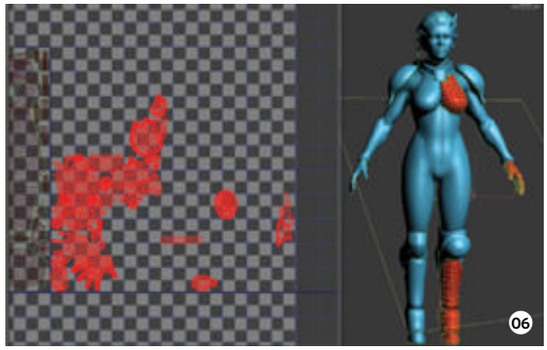
04 Keep the overall shape of your model in mind with regards to baking Normal maps. A few more edges could make or break the quality of your asset

Unwrap & bake

Prepare your model for texturing by making a UV map

05 Unravel & re-stitch This stage is tedious, but absolutely necessary to get right. I prefer to use the Unwrap UVW modifier, isolating areas and map planar elements, then stitching them together within the UV Editor. When unwrapping, the key thing to keep in mind is readability. Beyond this, you need to consider the real estate your character is taking up. Avoid stretching and keep a consistent texel density, which can be tested by applying a chequer material to your model. Carefully consider the placement of your seams and try to keep them hidden or have them follow a natural line.

06 Manage your models To speed things up I try to duplicate assets as much as possible. For this character the hands and boots only need to be created once. Consider modelling just one, unwrapping it fully and then baking textures and duplicating it afterwards. Once your model is ready, split it up into different elements to quickly get the portions separate for cleaner bakes. Try to avoid overlapping geometry or including pieces that may catch conflicting information during the bakes. A good example for this character is separating the shoulder armour from the body, as you don't want model information from the body captured onto the armour and vice versa.



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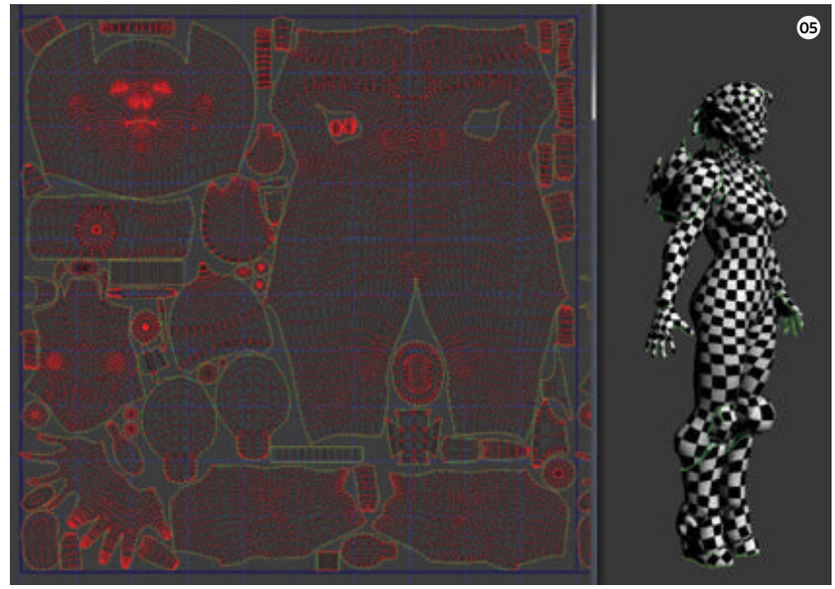

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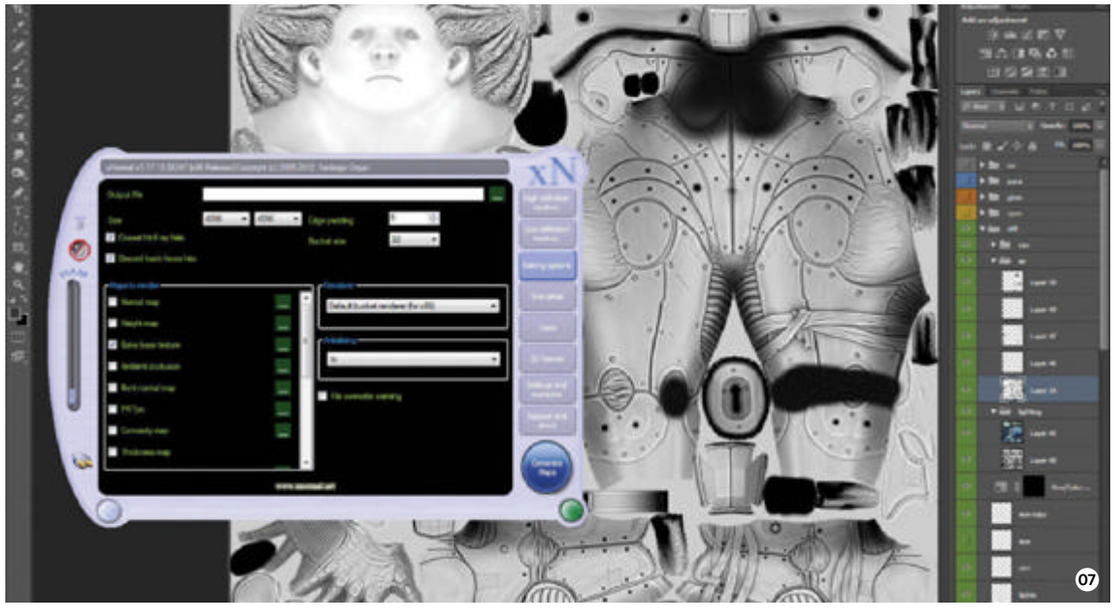
07 Generate Normal & AO maps There are various ways you can bake down Normal and Ambient Occlusion texture maps. To avoid bogging down my machine I use xNormal, which is an application made to generate a series of textures without using a viewport. Simply navigate to the High Definition tab, load the models you wish to use as a target, then navigate to the Low Definition tab and select the low-poly models you need to generate textures for. You can set the Raycast limit, which is the maximum distance the program will search for high-resolution detail, as well as which type of edge information you would like (preserving Smoothing Groups or not). Once everything is ready, navigate to the Baking Options tab, select the type of maps you need, the size and the destination for the saved files, then click Generate Maps. Your chosen textures will be generated quickly.



07

Overlapping UV islands

A smart way to optimise the real estate that your model takes up in your UV map is to overlap UV islands. If a model is going to appear exactly the same in the final result, why bother giving two exactly-the-same pieces texture real estate? Instead, stack these UV islands up and give the new space to other elements that could benefit from more pixels. For this character, the hands, boots and armour pieces were not made to be unique. To avoid errors while baking I grabbed the overlapping island and offset the UVs by 1. This positioned the UVs in exactly the same place, where the texture was tiled, and avoided any conflict when I was generating the Normal texture maps.

05 Use a chequer material to test texel density, stretching and placement of the seams

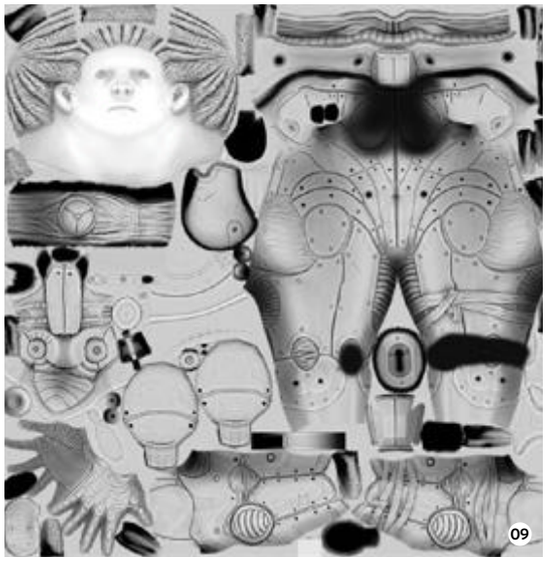
06 Split your model apart for cleaner bakes when generating Normal and Ambient Occlusion maps

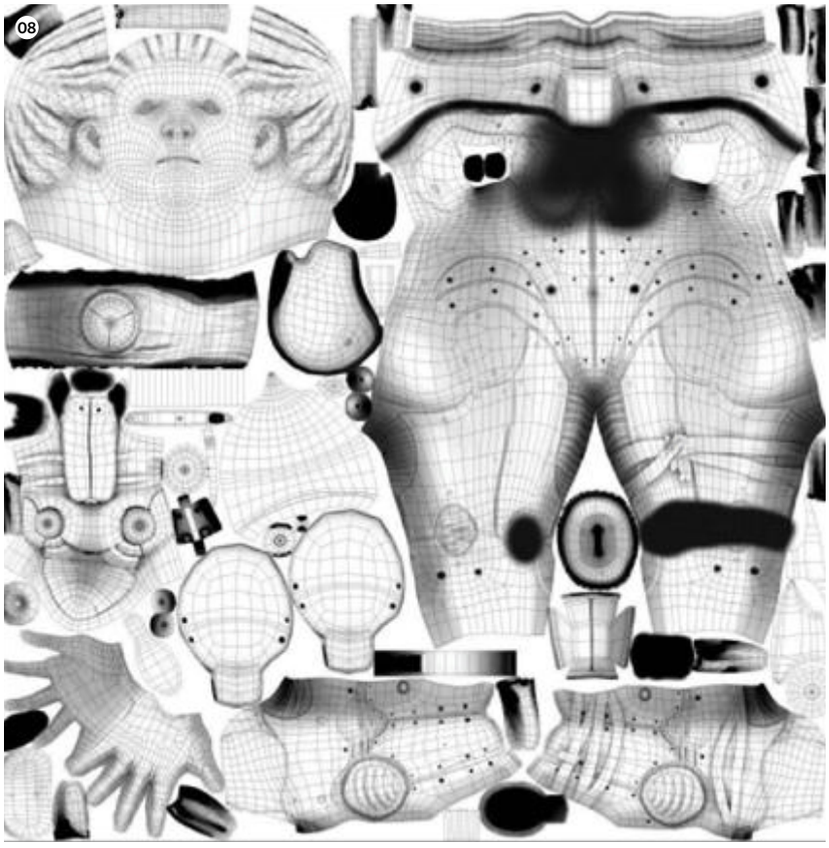
07 xNormal is a great application for quickly generating Normal texture maps

Texture the character

Produce a basic texture set for your model

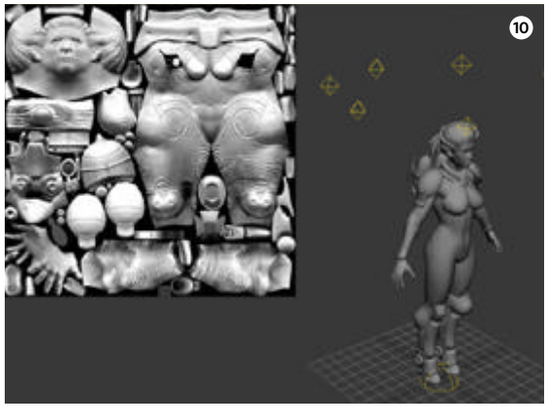
08 Use baked maps as a guide When the Normal and Ambient Occlusion maps have been made, compile them into one PSD using the Alpha textures generated, with the bakes as a mask. This achieves various islands of information for the textures. Use the ambient occlusion information as a rough guide to paint details that will line up with the high-resolution model or Normal map information. Keep in mind that too much baked-in lighting information will conflict with real-time lighting – use baked-in shading wisely!





09 Create Cavity maps Open up CrazyBump, which has a full free demo (**www.crazybump.com**), and load your final Normal map. Once this is loaded, you will be able to tweak the settings in the Displacement, Occlusion and Specularity slots. I usually try to generate a tight Occlusion map for cavities and a Specularity map for highlights, which are then multiplied or overlaid on top of my Diffuse map. Since the Ambient Occlusion map takes care of broader details, the Cavity maps are intended to pop out smaller aspects.

10 Apply Light maps Another step that I take to help the texturing process is to bring the Normal-mapped model into a scene with a basic Omni light rig. Using the Render to Texture panel (press 0 in 3ds Max), you can render out a simple Light map. This will generate a texture, showing Normal-mapped detail reacting to the lighting coming from above. This texture, set to a very low-opacity overlay, helps ground the character in the world of the game, as well as enhance depth for the final Diffuse texture map.



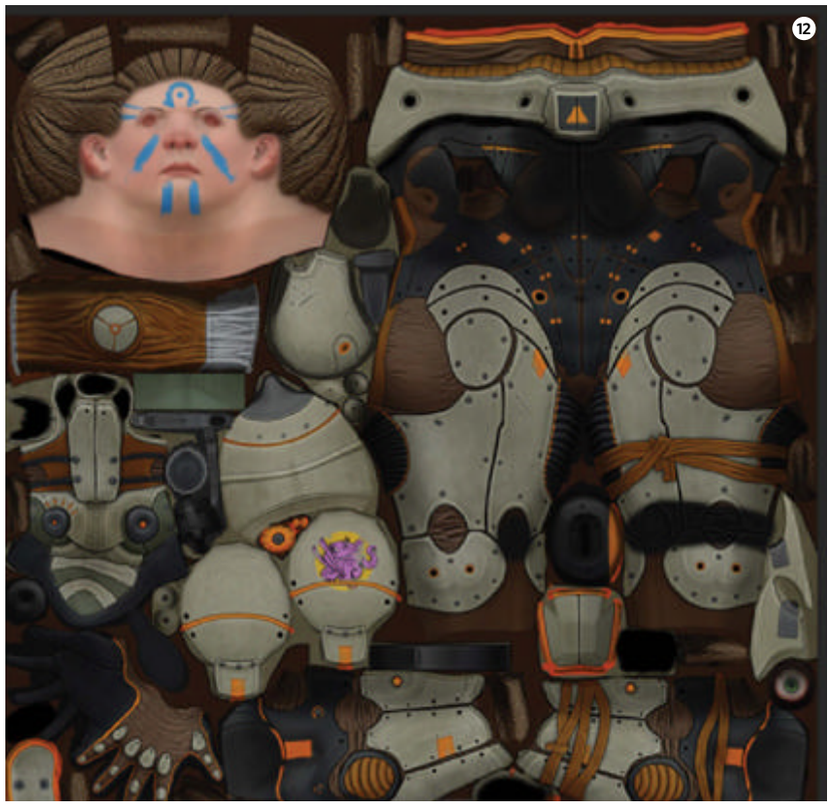
11 Paint the base colours Now block in bigger details with colours to match the provided concept. These define the different materials within the texture without going into too much detail. I don't worry about dirt or grime at this stage, focusing only on low-frequency readability and using broader strokes that can be seen at a distance. This character mostly uses a colour scheme of three tones to prevent any of the details becoming confusing.

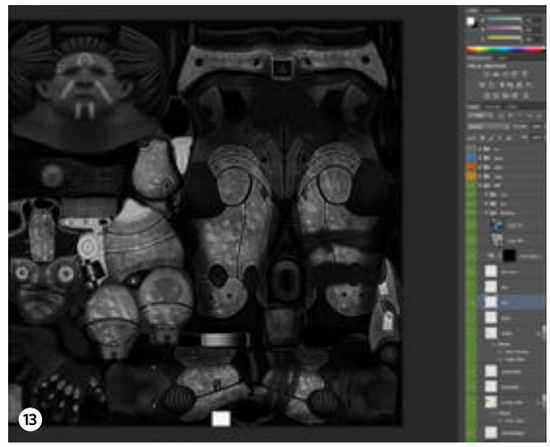
08 Use subtle Ambient Occlusion maps as a guide for large-scale details

09 CrazyBump can generate Cavity maps that will help pop out details in the texture

10 Used subtly, Light maps can help ground your character in the game world

11 Start texturing your character with basic colours and worry about the details later





Defining different materials

Part of what makes an interesting character is the breakup of materials. This can be as subtle as a button on a shirt, or as extreme as chrome armour over a matte surface. This character has great material variations throughout her costume – namely the different types of armour paired with a spacesuit material with low reflectivity. To ensure the material is of the best quality, define specularity as well as diffuse information, rather than simply adjusting the reflectivity of a surface after the fact. One map should inform the other and each are equally important.

12 Apply small details to give the character life. Wear and tear can really evoke a story in the viewer's mind

13 Produce a Specular map in tandem with your Diffuse map to sell material variations with a range of values

14 Use a viewport shader to help preview your work in a near game-engine environment

12 Refine & add details Start breaking up the model with smaller elements, like icons, decals, dirt and so on. This is where surface-level details come into play, to flesh out the model's history. The majority of the model can be hand-painted using a hard round brush, with the help of Light and Cavity maps. You can add a metal overlay to the lighter armour, to help break up the surface. The Diffuse texture map is intended to be the base colour of the surface without any lighting being added to it. Applying too much detail as a result of lighting effects can make the material seem flat.

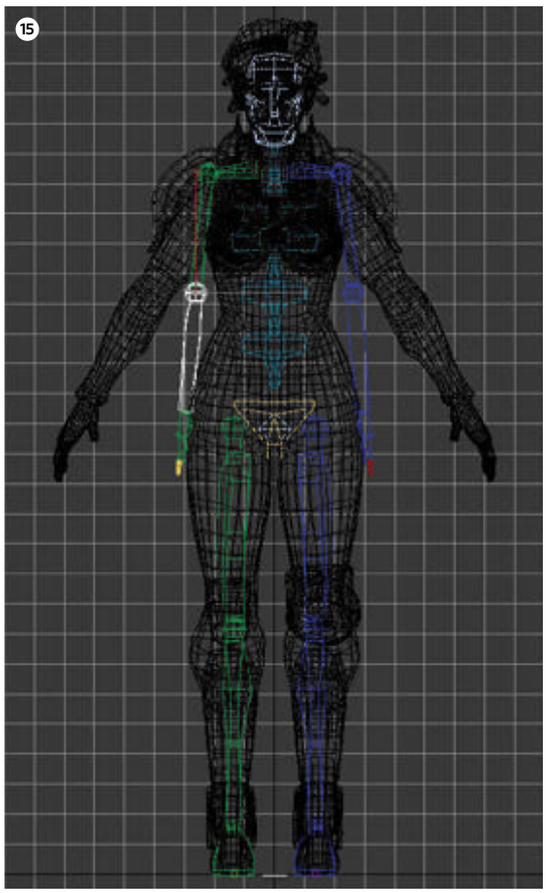
13 Build a Specular texture Often a Specular map is an afterthought, but this shouldn't be the case, as the reflectivity of a material will help sell the differences within a surface. While producing a Diffuse texture you should also be creating a Specular map in tandem. Separate materials should have an obvious difference in value. Generally the closer to white the texture is, the more reflective it becomes. Therefore, white represents chrome and black represents matte. When creating a Specular map, remember that some details will exist there that shouldn't in the Diffuse texture.

14 Review your work To preview my progress, I use XoliulShader 2 (available from **http://viewportshader.com**). It's free, easy to set up and is accurate to how a game engine will display your work. Open the Material Editor, set the material type to Xoliul and load in the textures you need. Now apply the Diffuse, Normal and Specular maps, as well as a quick Glow texture. You can also add rim lights, reflections and tweak how the material renders in your final shader. At this point I also enable reflections, a subtle rim light and load in an Environment map, provided with the shader, to control what's being reflected in the final material.

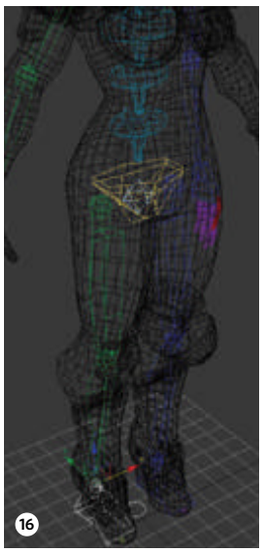
Rig & weight the model

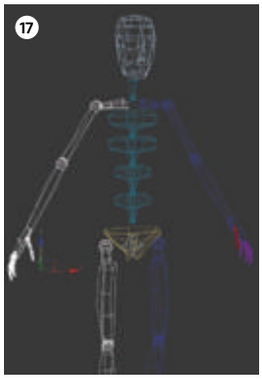
Make a quick skeleton to pose your character

15 Use a Biped skeleton 3ds Max has a great rig perfect for characters like this, called 'Biped'. Locate the Biped option in the Create>Systems tab. After selecting this, change the viewport to Front, then click and drag. This generates a Biped rig that you can then fit to your character model. Once the Biped has been placed, adjust different parameters within the rig itself, like the amount of fingers, spine bones and toes. This character uses five fingers, three spine bones and just one toe for the boots.



16 Adjust the bone position It's unlikely that the Biped rig will fit perfectly to your character, but that's okay. You can easily adjust the placement of bones by first navigating to the Motion panel and clicking on the Biped Figure Mode icon (a stick man). Select the bone you wish to change and either move, rotate, or scale it into place. For this character I had to make minor adjustments, like the position of the shoulder. The major changes I needed to make, mostly due to the stylisation of the character, were the placements of the hands and fingers, the hip position, the length of the legs and the position of the head.

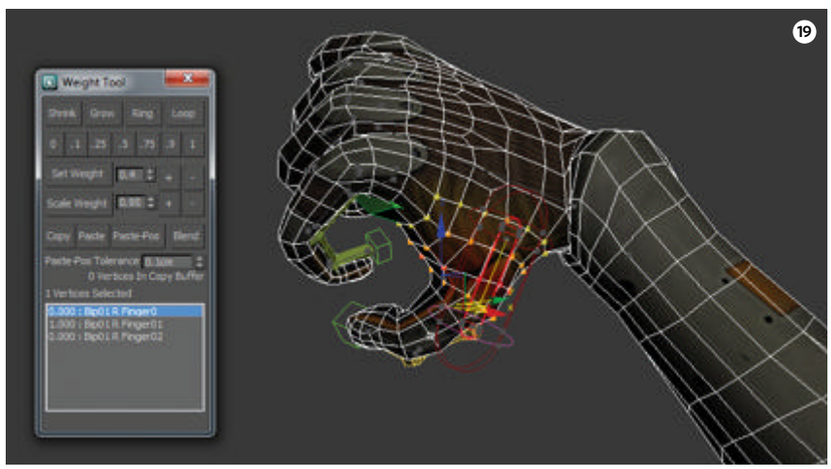




17 Mirror the Biped skeleton When adjusting the position of the bones within your Biped rig, you only need to worry about one side at a time. Since this character is symmetrical, you can easily mirror the information from one side to the other, which crucially saves a lot of time. Select all of the bones making up the adjusted half of your model, then navigate to Copy/Paste in the Biped menu. Create a new copy collection, click Copy, then Paste Opposite while in Posture mode. This will instantly copy the adjusted bone position to its symmetrical counterpart.

18 Apply some weight Now you need to bind your model to the newly created skeleton. Disable Figure mode, select your character model and use the Skin modifier. Once this has been added, go to Advanced Parameters and change the Bone Affect Limit (that will influence a vertex) to a number no greater than 5 (the default is 20). This helps keep the influences on a vertex cleaner, but is also more true to a videogame environment. Generally the more influences a vertex has, the more calculations that will need to happen. Some hardware will even have rendering issues with vertices that have too many influences – so keep it simple and don't use more than you need.

19 Manually modify the influence Once you've applied the Skin modifier, you'll also able to tweak the influence a bone has over a given vertex. A good way to do this is to rigidly weight a vertex to the nearest bone and smooth out the transition from there. When adjusting the character's arms you can weight all vertices for the upper arm to its relevant bone and the same for the forearm. After this you can select a loop of vertices at the elbow and blend them to the opposite bone within the Weight tool's options (the wrench icon).



15 Use the preset Biped system for achieving a quick character rig

16 You can easily change the bind position of your skeleton's bones by entering Figure mode and manually moving bone objects

17 Use the Copy/Paste feature within the Biped menu to mirror changes you make, for interesting bone positions

18 You can use the Skin modifier to bind your model to the Biped skeleton

19 Using the Weight tool, you can manually adjust how much influence each bone has on a vertex

Consider the scope

When working on your character it's important to consider what the project actually requires. For example, this model is intended to be just a portfolio piece with only a simple pose. This means that the total triangle count within the model can be a little higher, so long as it improves the visual quality. This means the textures can be created at a higher resolution than normal and the rig only needs to be able to achieve a few basic poses, with minimal distortion. Unless you are intending to fully animate the character, you can save time by weighting it to favour your own specific requirements.

20 The Skin Wrap modifier Another invaluable tool that you can use to bind your model to a skeleton is the Skin Wrap modifier, which basically enables a model to follow another weighted surface. I find that this is extremely useful for elements that could take a long time to get right, like belts or straps that are layered over the core character. With the Skin Wrap modifier applied, select the target surface and then click Convert to Skin to copy the skin information from the target surface. You can then adjust the Skin modifier on its own if any additional cleaning up is required.

21 Make tests with interesting poses With your rig selected, you can enable Autokey towards the bottom of the screen and move the bones of your character to automatically save a keyframe within an animation. I try to save a few extreme poses that will test the limits of the rig. For the most part, poses produced during exercise are good references to follow. A jumping-jack pose, for instance, will test how the model will deform during common animations.

22 Manipulate the character's skeleton Similar to the test animation for deforming the model, you can also set up animations to switch between various poses. By scrolling ahead in the timeline, you can create a few poses that can then be manipulated later, all without destroying the bind pose of your character (that will be frame 0). When posing your character, you can also adjust its weighting as needed, based on your requirements for the final render.

23 Set up the final render Once you've settled on a suitable pose, it's time to create a more advanced setup to finish. Often I find applying a three-point lighting setup using separate Omni lights – a strong key light, a fill light acting as ambient bounce and a back light – produces the strongest results.

Your game-art portfolio

Always consider legibility when building renders for your portfolio. The point is to display your work in a way that doesn't obscure details or deform your asset. Dropping your character out of a bind pose, even a small amount, can help add personality to it and still show it off in a less confusing way than, say, an action pose. In the same vein, you should also consider a lighting setup that doesn't obscure your character in shadows or coloured light, but still brings out detail with light and shadow.

20 The Skin Wrap modifier can quickly weight things like straps to a character's body

21 A swift animation using active poses can help test the limits of your rig

22 You can create a variety of poses by saving keyframes on your skeleton

23 By using XoliulShader 2 again, you can apply a three-point lighting setup to achieve your final result

I made this...

Incredible 3D artists take us behind their artwork

Artist info

Sébastien Lardillet

Website www.seblardillet.blogspot.co.uk

Country France

Software used ZBrush, Photoshop, CINEMA 4D

Bio Sébastien is an experienced illustrator and graphic generalist

Why can't we be friends? 2013

For Christmas I gave my son a great book by Jonny Duddle called *The Pirate-Cruncher*. When reading this book for him I felt the desire to create a pirate-themed picture. I wanted to re-create the atmosphere of an 18th-Century tavern, just like in Jonny Duddle's book. I'm also a huge fan of the work of Serge Birault – which is why the second character is an octopus, a symbolic element in his work. And more fun to drink with!

Software used in this piece

ZBrush | Photoshop | CINEMA 4D

"For details like hair I simply used the Hair module in CINEMA 4D. The result is very satisfying for just a few minutes' work"

"The Transpose Master plug-in for ZBrush is extremely powerful. It also makes rigging fast and easy"

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Artist info

RenPeng Dong

Personal portfolio site
www.oldrhyme.cgsociety.org

Country China

Software used
3ds Max, Maya, ZBrush, Mudbox, Photoshop, V-Ray

"I saw an image on a website that was like a kind of transparent man blending with his background, which brought me this great idea... [I] decided to show the feeling of part drying paint, part real, part plaster"

Non-US readers turn to page 56

MJAE 2013

Animate vehicles in Maya

One giant leap for car-kind 2013

Jahirul Amin is a freelance rigger, animator and an associate lecturer at the NCCA, Bournemouth

The control rig

Step by step

Easy-to-follow guides take you through the creation process

Artist info

Jahirul Amin

Personal portfolio site www.warpeaceandpixels.com
Country UK
Software used Maya
Expertise Jahirul is an expert animator and rigging genius

Learn how to

- ☑ Prepare a rigged vehicle model for animation
- ☑ Use the CV Curve tool, Graph Editor and motion trails to plot a dramatic stunt
- ☑ Manipulate weight and drag for realistic results
- ☑ Adjust control points to replicate believable physics

With the Disc

Tutorial files:
- Maya scene files
- Video animations
- Helpful scripts for Maya
- Tutorial screenshots

Animate vehicles in Maya

Hey, who took the bridge?

Having modelled and rigged our car, we can now finally take it out for a spin. We'll be hurtling down a stretch of rough road, then taking a jump over a broken wooden bridge. This little stunt will definitely test out our rig and we'll need to play with the suspension and tip the car using the pivot controls. We'll also have to make sure the car doesn't penetrate the environment as it travels over the bumpy surface, most likely by adding extra keyframes, then finally adding weight as the car hits the ground after the jump. So grab the supplied tutorial files and let's take a look.

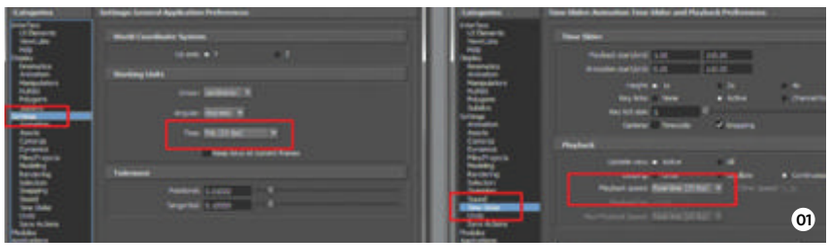
Thanks to the millions of petrol heads out there, you'll find more reference than you could ever need online. This is especially handy to help you work out the timing, as well as to observe small details that add texture to the piece. However, there's no substitute for first-hand resources, so if/when you drive, really feel the way the car moves in response to changes in surface, shifting gear and so on.

In terms of approach and technique, we'll come at this task as if we were completing a character animation. We'll lay out the broad strokes to begin with and try to get the timing right before adding any finer points. When the timing is just right, we can add detail layer by layer, tweaking that timing as we go. The problem with attempting any detailed work before the timing is sorted, is that if you need to significantly rework it, you've got to undo the detail added on top in order to fix it, which I find pretty soul-destroying. Technique-wise, we'll be using the very useful Editable Motion Trails, which enable you to see the path your object (here, the car) is following. They also enable you to edit the motion live in the viewport.

Before we hit the steps, I'll run through the process briefly. First we'll set our animation preferences, create a custom shelf, frame our work and make a camera to work to. Then we'll block out the motion of the car, first moving it from A to B, then working and reworking the timing to get it looking believable. Next the layering begins, so ensure the wheels don't penetrate the surface of the road and add weight by playing with the suspension. Finally we'll add details such as the damage to the car on landing, the movement of the wooden bridge struts as the car hits them, and animate the character in the driving seat.

Start the engine

Check the settings & create a camera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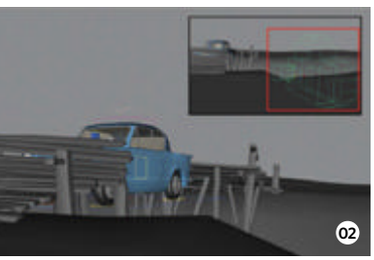
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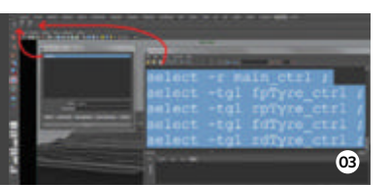

03

01 Setting Time preferences before we start

02 Framing the shot

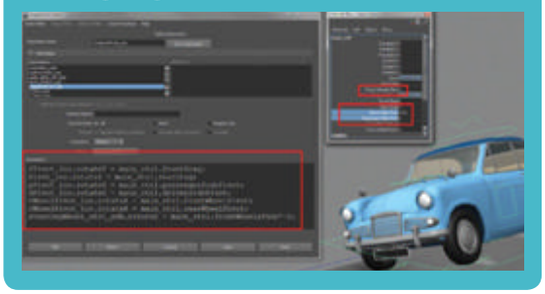
03 Creating camera bookmarks and selection tools

01 Tweak the animation preferences Before we drive, we need to check the animation settings. Go to Window>Settings/Preferences>Preferences and scroll down to the Settings category. Under the Working Units, set the Time to PAL (25fps) and then go down to the Time Slider tab. Under Playback, set the Playback Speed to Real-time [25fps]. If you're used to working at 24 or 30 frames per second, feel free to set it to this. As the car will travel between keyframes, set the Default In and Out Tangents to either Auto or Spline under the Tangents in the Animation tab.

02 Place the camera Go to Create>Cameras>Camera and rename this 'render_cam'. Open the Render Settings under Window>Rendering Editors and set the Image Size to either HD 720 or HD 1,080. Select the newly created camera in the Outliner, then in the viewport panel go to Panels>Look Through Selected. Position your camera where you think is best and turn on the Resolution Gate to help you frame your shot. I ended up tweaking the camera slightly throughout the shot, so as to frame the animation better as I progressed. However, working to one main camera means you can cheat a few things should you need to.

Modifications to the rig

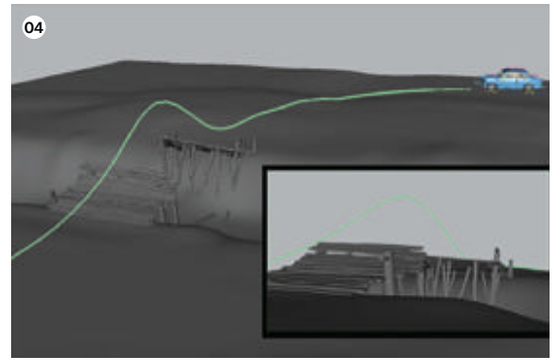
I've made a few tweaks to the rig that we created in issue 53 to make it fit for purpose. First I added an attribute to allow for pivoting independently from the driver or the passenger side. I also created a control for the steering wheel and hooked it up to the Front Wheels Turn attribute, so the steering wheel will turn with the tyres. Finally I popped a character (Box Boy) into the car, parented his IK hand controls to the steering wheel and constrained his root_ctrl to the car's body_ctrl. Check out the scene file 'rapier_rig.ma' to see these changes and have a play around before beginning the tutorial.



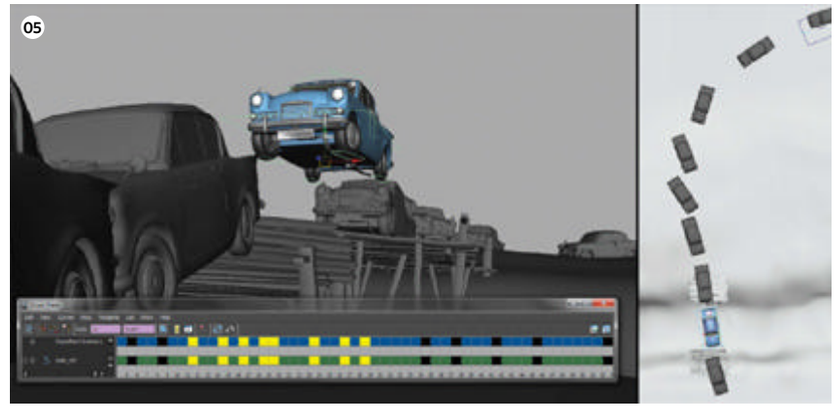
03 Custom shelves & shortcuts Create a new custom shelf and call it 'car_anim'. In this shelf we'll make a shortcut to return to our camera view, as well as a shortcut to select the main controls that we'll be keying in this shot. Looking through the render_cam viewport, go to View>Bookmarks>Edit Bookmarks. Select New Bookmark and then Add to Shelf. If you aren't quite decided on a final camera angle, create a few bookmarks to switch between. Next select the following controls: main_ctrl, body_ctrl, fpTyre_ctrl, fdTyre_ctrl, rpTyre_ctrl and rdTyre_ctrl. Open up the Script Editor and highlight the commands from the History and middle-mouse-drag them onto the custom toolbar. When it prompts you to Save Script to Shelf as Type, select MEL.

Move from A to B

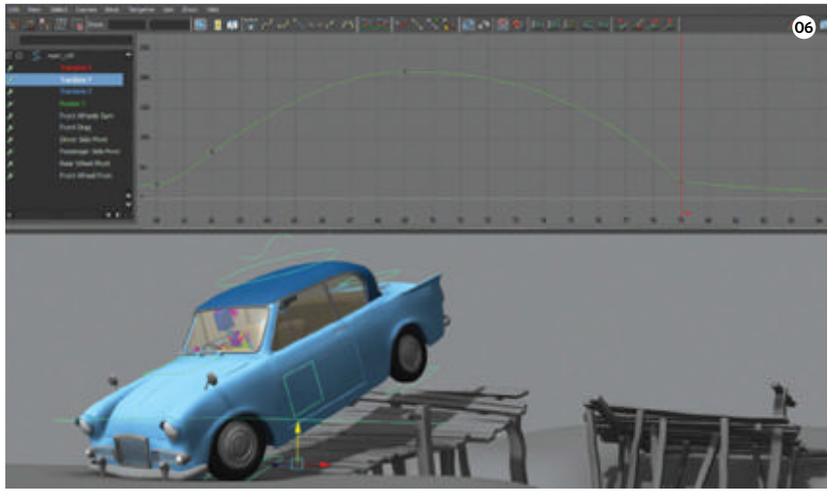
It's all in the timing; details can wait



04 Apply guide curves Before I begin animating, I like to create a curve to help me figure out the path the object will follow. Go to Create>CV Curve Tool or Pencil Curve Tool and make sure the Curve degree for either is set to 3 Cubic. Navigate to the top view and create a nice path from the top-right corner of the environment and over the bridge. If you're using the CV Curve Tool, make sure you make several clicks from start to finish, enabling better editing of the curve. Now tweak the vertices, as they'll currently be flat on the surface. Once you're happy with this, use the car's globalSRT_ctrl to position and rotate it in the direction of the curve .

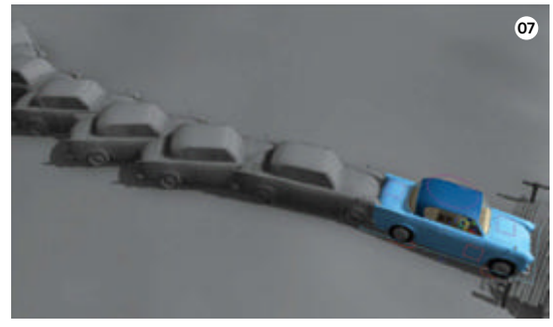


05 Block out the controls To translate the main mass of the car we'll block out the main_ctrl. Only focus on translating the car in the X and Z axes initially and don't worry about the up-and-down translation too much, other than on the bridge. When the timing is refined later on, we'll come back and clean the up-and-down translation, so the car will sit on the surface better. As we have to deal with both Translate X and Z in the Graph Editor, things can get pretty tricky when trying to get them to work together. Luckily we can use the Create Editable Motion Trail tool, which you'll find in the Animate menu. With the main_ctrl selected, run the tool to create the curve of the path the car is following. You can now – live in the viewport – use the handles to edit the trajectory. This is a very useful tool when animating a shot like this.



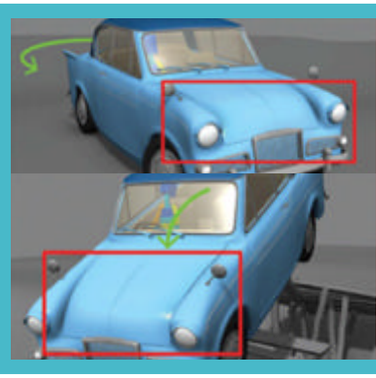
06 Re-time the animation & make an impact Once the main blocking is complete, we can really start concentrating on the timing and try to get it to a state where only minimal changes may be needed later. Try to think hard about the weight of the car and how the front (where the majority of the mass is) will behave. Use the Front Wheel Pivot and the Rear Wheel Pivot attributes to lift the car up from the broken bridge, and then also to add weight as it comes crashing down. As the car comes down, we can consider the principles found in a bouncing ball animation: the spacing increasing gradually and then the sharp contact, to help convey a sense of weight and impact.

07 Replicate the drag At this point we've got the car running at some speed and the first turn is pretty sharp. To help strengthen the idea of a speeding car, use the Front Drag attribute on the main_ctrl to delay the rear of the car. This will also help enforce the idea that the main weight of the car is at the front, causing the rear to fall behind. As the car begins to straighten up before the jump, you could also add some drag in the opposite direction. Doing this will bring a little texture to the animation to prevent it becoming too clean-looking and boring.



Where is the weight?

During this process I was constantly considering where the weight was in the car. For this model the engine would be at the front, so as the car swings the rear will drag. As the car comes down from the jump, it's the front that will lead and hit first. Stunts like those performed in *The Dukes of Hazzard* had the boot stuffed with weights to soften the landing and stop the car from nose-diving. Think about what would be physically plausible first and if you need to exaggerate slightly, do so.



04 Using curves as guides helps to project the flight path

05 Use the Dope Sheet to help edit the timing

06 Bring impact to the landing using the Graph Editor

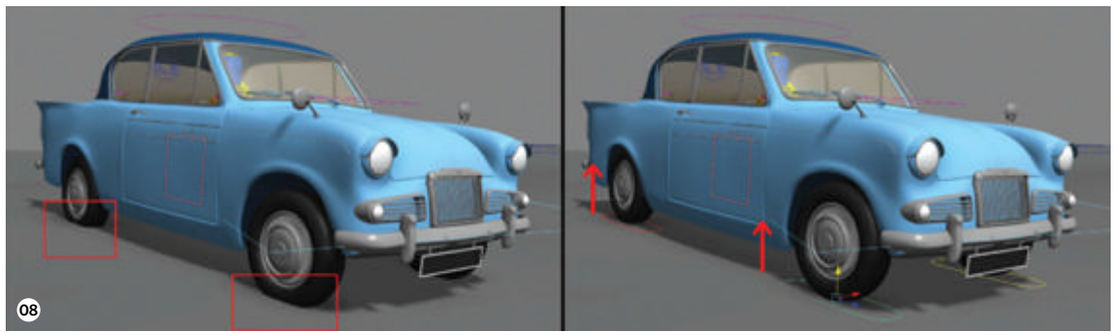
07 Add texture by dragging the rear of the car

Adjust the tyres & suspension

Apply weight & keep the tyres on track to maintain the illusion

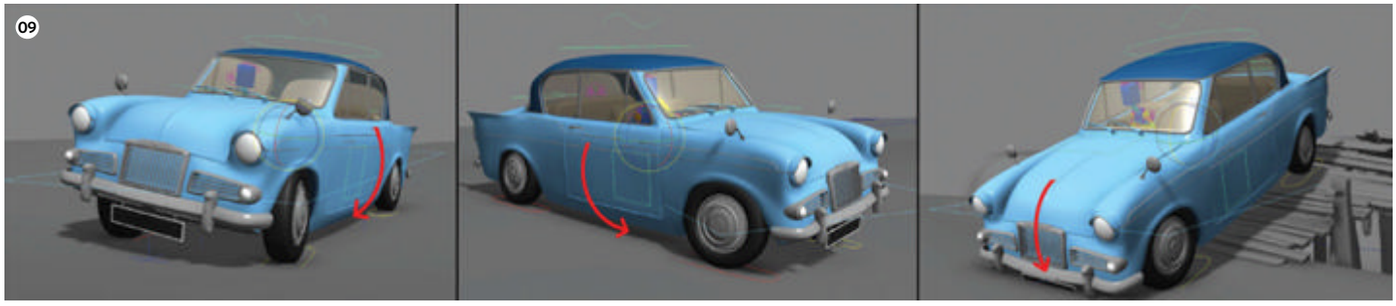
Motion trails

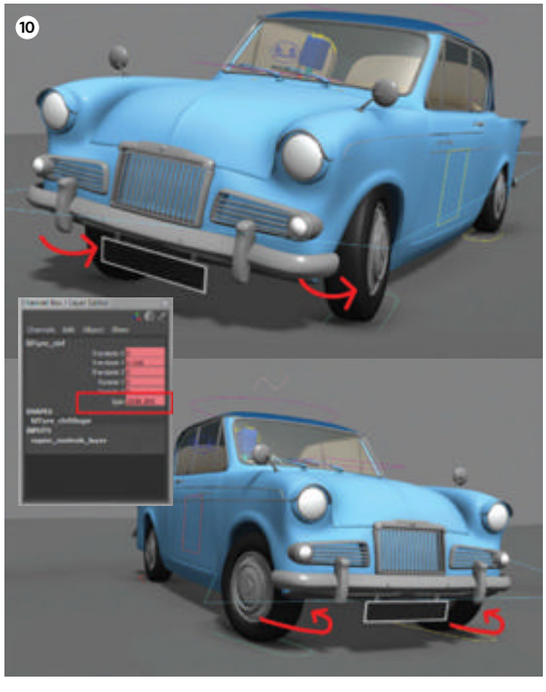
Whether you're animating a character or a hard-surface object, you'll want to make sure the arcs created are appealing to the audience's eye. I've supplied a script created by a colleague, Constantinos Glynos, called 'CG_VertexMotionTrail_v2.py'. This enables you to take a selected vertex and create a motion trail from it. Here I've checked that the trails created by the tips of the car's wings flowed.



08 Stay on the surface By now we should have the main beats of the animation, so we can begin cleaning up and layering in the details. Go through the tyres one control at a time, using Translate Y to keep them on the surface rather than penetrating it. Keep the geometry of the wheels and the environment in smoothed mode, as viewing unsmoothed may give slightly odd results. As the surface is so bumpy, especially as it travels up and down the bridge, you'll probably find that you have no choice but to set a key on almost every other frame – if not, a frame here and there.

09 Animate the suspension Once the wheels are sitting well on the surface, use the body_ctrl to bring the feeling of suspension as well as further appeal to the animation. As the car makes the first big turn, rotate the body_ctrl away from the turn and then hit it in reverse. Delay the body_ctrl so it's always trying to catch itself. As the car comes crashing down, you can really help sell the impact by rocking it back and forth a few times before settling. With the combination of the movement in the wheels and the suspension, this will help add some life to the animation.





10 Tweak the tyres For the wheels, disable the autoSpin attribute on the main_ctrl and use the Spin attribute on each tyre control. This enables us to edit the speed of the tyres spinning at different stages. For example, when the car is travelling through the air, the front wheels need to slow down but the back wheels should spin at a faster rate. You can apply something similar for when the car makes its first major turn. You may find that due to the style of the hubcaps it's pretty hard to see the wheels spinning, but adding motion blur can help sell this effect. To turn the front wheels, use the Front Wheels Turn attribute on the main_ctrl.

11 Place the driver To have this car with either blacked-out windows or no driver would look odd, so pop BoxBoy in to let him take it for a spin. We can use this to our advantage, as it enables us to replicate the bumpy ride. By adding some delay and overlap to the upper body and the head, we can sell the idea of this car careening around and slamming down. You don't have to spend too much time here as the motion of the car is fast, but even these small details help add some reality to the animation. You'll also have to use the Elbow attributes in the IK hand controls to stop the elbows from popping about.

08 Make sure the wheels aren't penetrating the surface

09 Add more weight by rocking and tilting the main body of the car

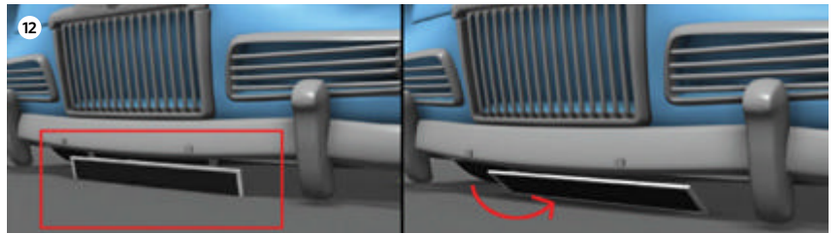
10 Turn the wheels and add some spin to them

11 Create further drag and overlap by animating the BoxBoy driver

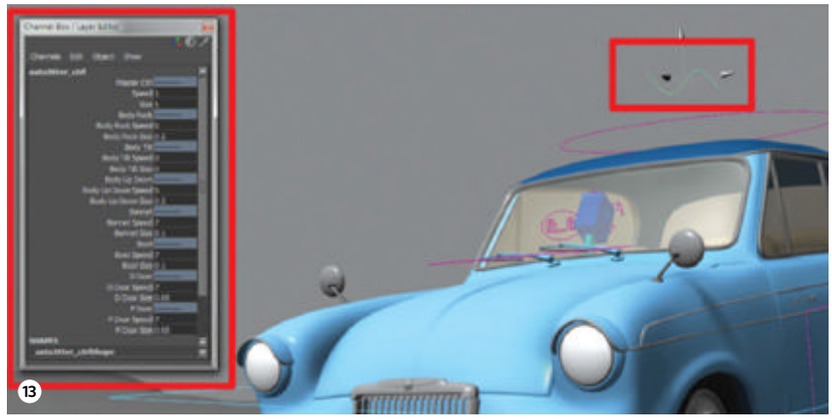
Add more details & texture

Small points will make all the difference, so let's add some

12 Include bumps & breaks In order for the front of the car to crunch the floor on landing, the licence plate will have to penetrate the floor for a couple of frames. Although there's no control for the plate, we can animate it to move slightly backwards as it contacts the floor. You may have to edit the pivot point to be able to rotate it from a better position. To do this, simply hit the Insert key on the keyboard before you set your keyframes.



13 Apply further jitter For greater interest, we can include more detail for the car's vibrations and jitters. Use the autoJitter_ctrl with the following settings: Master Ctrl Speed: 1, Master Ctrl Size: 1, Body Rock Speed: 6, Body Rock Size: 0.2, Body Up Down Speed: 5, Body Up Down Size: 0.2, Bonnet/Boot Speed: 7, Bonnet/Boot Size: 0.1, D Door/P, Door Speed: 7, and D Door/P Door Size: 0.05. Try experimenting in a clean scene with just the car, as it's hard to see the effects in a fast-moving vehicle – but they do add to the overall animation.

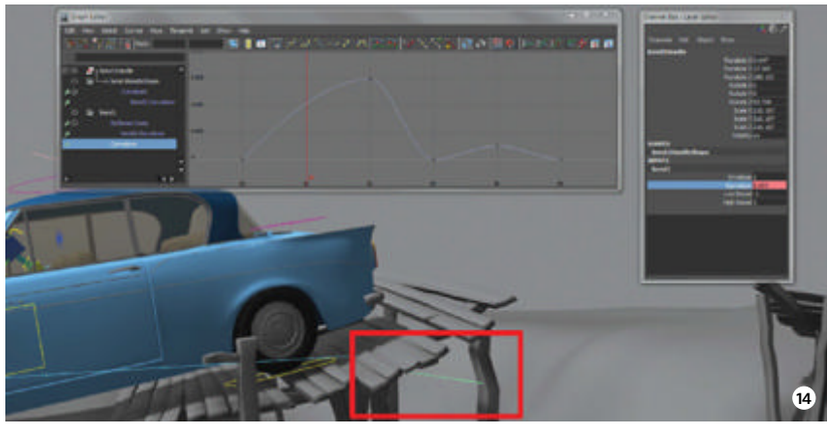


12 Apply some minor damage

13 By adding subtle jitter on top of our main animation we can increase the believability

14 Use a bend deformer to add some vibrations to the struts

15 Clean up the animation's curves before signing off

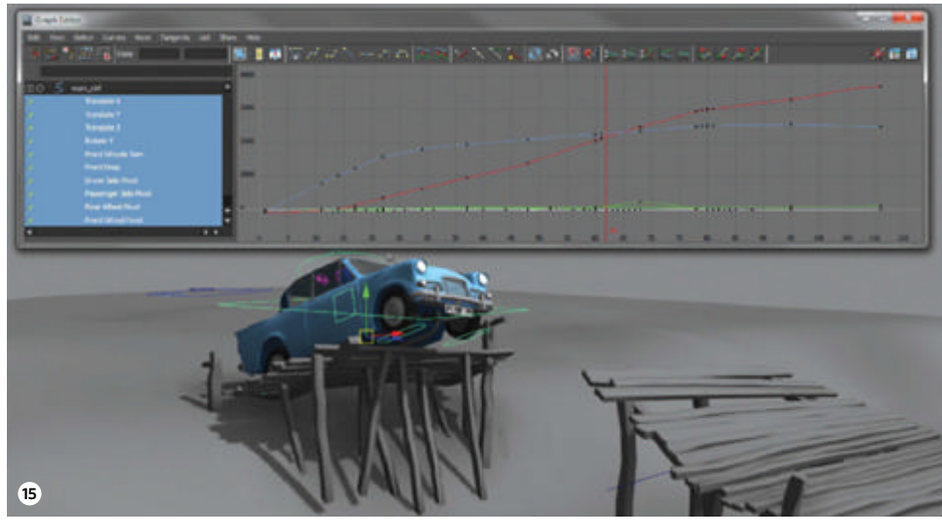


14 Interaction with the environment The last additional details can affect the struts as the car lands. To avoid animating each piece of wood individually, select the majority of the horizontal struts and navigate to Create Deformers>Nonlinear>Bend. Rotate the bend deformer 90 degrees in the Z axis and animate the Curvature attribute, found under Inputs, with very small numbers. I've hand-animated some of the vertical struts using the Rotate Z channel to reinforce the illusion of weight slamming down.

15 Clean up the animation curves Finally, check the curves and clean them up or delete any keys from attributes that have no animation on them. You'll know which attributes have no animation as you'll see a straight line in the Graph Editor. And now, you can take that brisk Sunday drive!

Light up your animation

Lights are awesome and I have a tendency to use them often when checking my animation. I like to create a directional light with Use Depth Map Shadows turned on and an ambient light with a very low Intensity of around 0.25. Adding Viewport 2.0 and turning on the Screen-space Ambient Occlusion really helps to show you if your models are penetrating the environment. Minor penetration isn't a bad thing, as it helps to sell the idea that one object is sitting on top of another – but go too far and it will look wrong!



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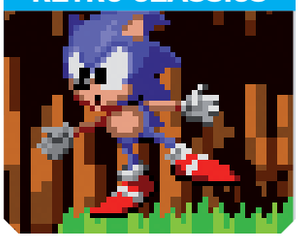

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I made this...

Incredible 3D artists take us behind their artwork

Artist info

Alexander Beim

3DArtistonline

Username: LotusArt

Website http://lotusart.de

Country Hamburg, Germany

Software used ZBrush, Maya, Photoshop

> Maya is my go-to tool for hair. To begin, I use Nurbs Curves. For added volume I attach Nurbs planes to the Curves. I can also use them again later to extract more Isoparms and curves for the hair curls

Software used in this piece

ZBrush · Maya · Photoshop

Bruce 2012

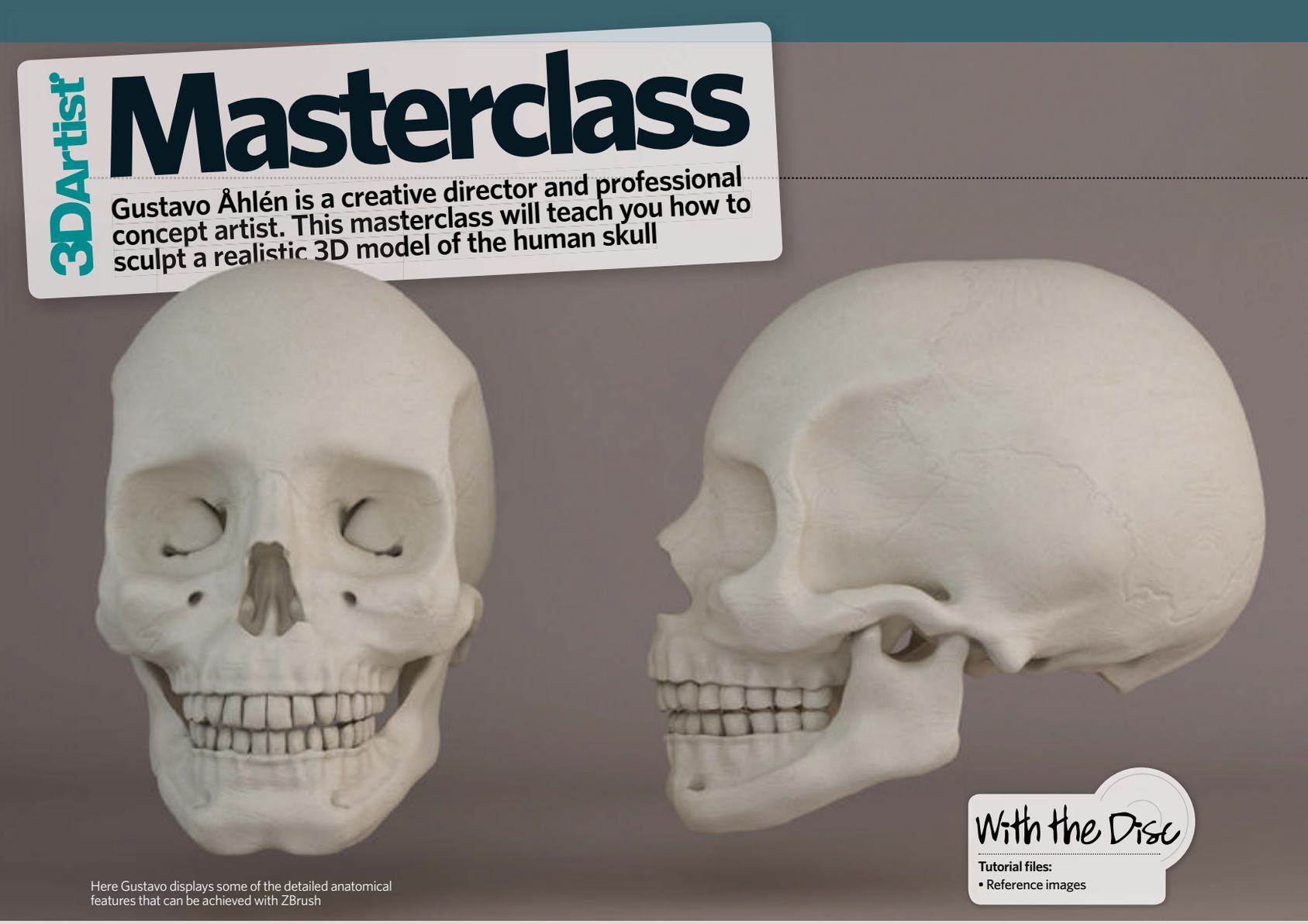
I have always been a Bruce Lee fanatic and of course I'm still very saddened by his premature death. With the development of 3D technology, it was never hard to imagine that one day we could completely replace live actors with 3D characters to be as realistic as they were in the flesh. Will actors that have passed away eventually be taking part in the films of the future? This question in principle spurred me to try to create my first portrait of Bruce Lee.

> I prefer to texture in ZBrush. I can instantly paint freely on a high-poly model with wrinkles and pores. Using a cavity mask, ambient occlusion and other features helps me to emphasise details in the model

3DArtist

Masterclass

Gustavo Åhlén is a creative director and professional concept artist. This masterclass will teach you how to sculpt a realistic 3D model of the human skull



Here Gustavo displays some of the detailed anatomical features that can be achieved with ZBrush

With the Disc

Tutorial files:
- Reference images

Sharpen your anatomy skills in ZBrush

> Here I'll guide you through my tried-and-tested workflow for sculpting realistic details

Whether you're a digital sculptor, illustrator or designer, this is a great chance to enhance your skillset as I guide you through creating a human skull from scratch. By completing these few steps, you'll quickly form an understanding of the basic primitive shapes you can use to get a detailed and believable model.

I highly recommend that you do a little homework on human anatomy before following these steps, as it will help to equip you for any problems you may come across during the process. By studying anatomical references, we can understand how the human body is formed, the parts it's made up of and the interplay between them. It's also always advisable to fragment your work where you can to allow focus.

Anatomically, the skull is the part of the skeleton that forms the shape of the head and supports the structure of the face. It's important to note that a human skull is in fact formed of eight bones, called 'synarthrosis joints', including skull bones (known as ossa cranii) and facial bones (ossa faciei). The bones of the skull are divided into two groups: the neurocranium (frontal, parietal, temporal, occipital, sphenoid, ethmoid) and viscerocranium (lacrimal, vomer, maxilla, zygomatic, nasal, mandible, inferior turbinate). It's important to consider technical descriptions to understand a little more about the separation between the bones you'll be modelling. It will also make the final steps, where you'll be shaping the subdivisions of the model, far easier.

From personal experience I've learnt that by reading books on anatomy, as well as drawing sketches of bodies in different positions, you can gain greater control over basic shapes. Through this careful study we can increase the overall level of realism in our sculptures. Each human skull is different according to the variations of its bone structure; many factors, including age, origin and gender, affect how a skull is shaped. This means if you choose to use a different reference image than the one supplied, you'll get a totally unique result.

In this tutorial we'll start with a simple sphere in ZBrush, then flesh it out step by step, using several of my preferred brushes and tools in ZBrush.

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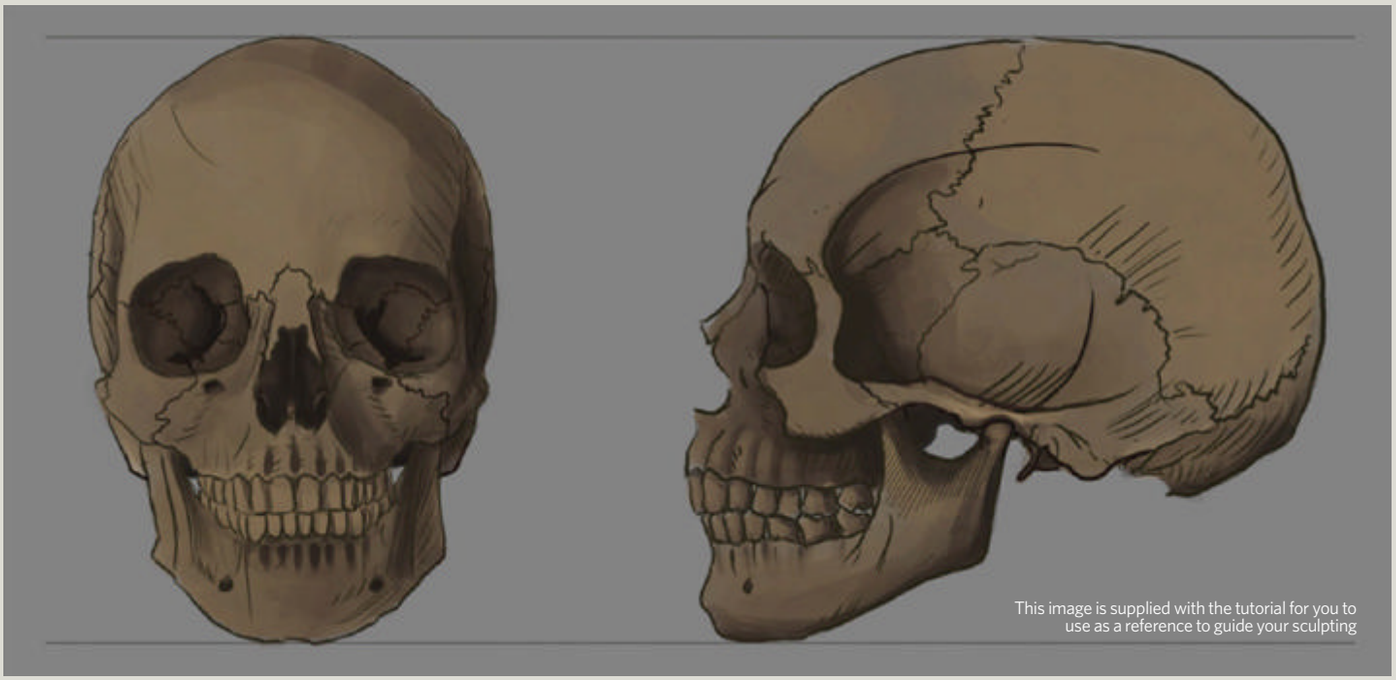


This image is supplied with the tutorial for you to use as a reference to guide your sculpting

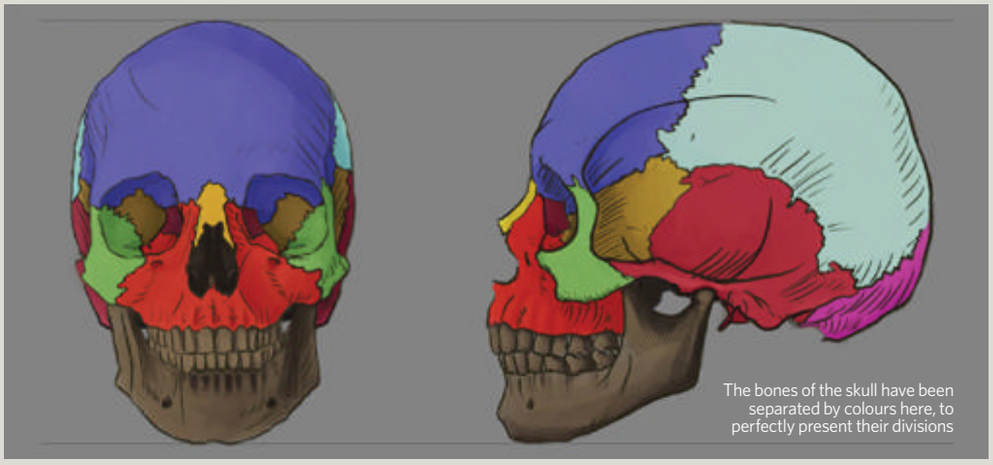
Grasp the complexity of the human skull

01 Start with basic shapes

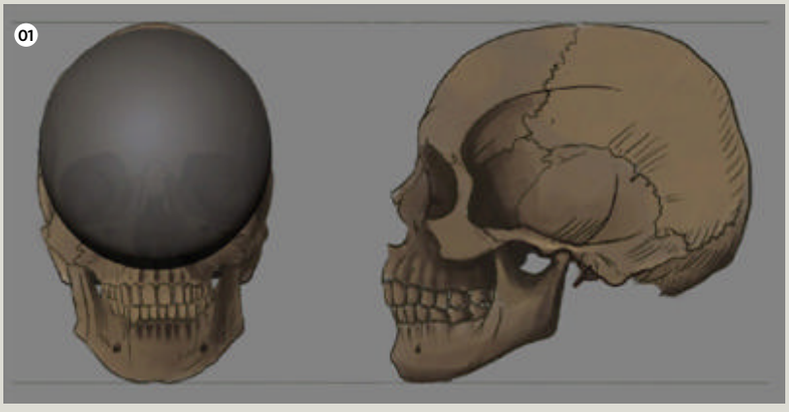
To begin we need to add a simple sphere in ZBrush and activate Edit mode. Navigate to Texture>Image Plane>Load Image and import the image used as a reference in this tutorial, named 'Reference Skull.jpg'. Now move the sphere above the front view of the reference skull.

02 Adapt the sphere

Looking at the frontal view, we'll convert our primitive sphere to a Polymesh by going to Tool and selecting Make Polymesh3D. Next go to Transform>Activate Symmetry and select the Move brush with a high Draw Size. Using the background image as a reference, activate the Transp option (Transparency). Now we need to adapt our sphere to the skull using the Move brush. A good tip is to alter the brush's size according to the scale of the reference.



The bones of the skull have been separated by colours here, to perfectly present their divisions

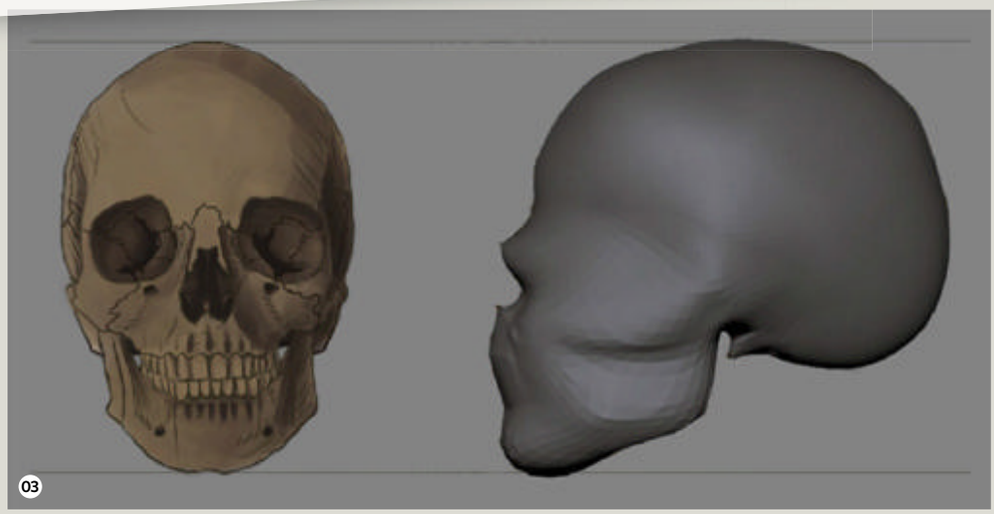


01 Starting the sculpt from a primitive shape helps maintain a more organic workflow

02 Adapting the primitive object to the frontal view to begin working on the facial features

Study the anatomy of the skull

Take a quick look at the supplied images (skull references) to familiarise yourself with the symmetry of each shape. Obviously, when we start this kind of work, we can choose different approaches that can make our workflow more effective, based on the result we are looking to produce. Usually when we begin an anatomy-based project, we're looking to achieve a balance between accurate and believable symmetry. This is also the case when approaching the human skull. I recommend enabling Symmetry only during the first steps, then disabling it later on to get some disproportion and realism.



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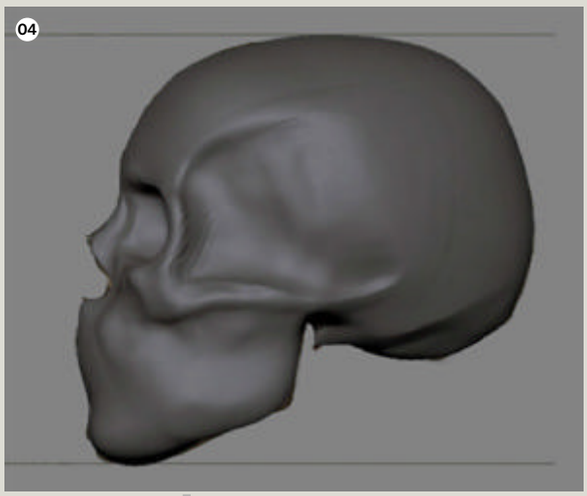


04

03 Develop the digital clay

Looking at the side view (the left side of the skull), continue applying the Move tool to adapt the clay to the reference image. In this case I also use the ever-useful Clay Buildup brush to add or subtract clay according to the requirements. I highly recommend using the Smooth brush to clear up any imperfections while holding the Shift key. This is a great method for getting the best-possible finish.

04 Flesh out the form

This step is vital for defining the shapes, because we need to begin dividing the mesh and increasing the number of polygons to get a detailed sculpt. Go to Geometry>Divide to control the subdivision level according to what you want. After doing this, redefine the clay using the Clay Buildup or Standard brush. For my sculpt, I prefer using the Clay Buildup brush to define an approximate model of the reference image. I can then clean it up with the Smooth brush. This rough model is a really useful starting point to build out the final model.

03 Adapt the primitive objects to the side view

04 Slowly build up the definition of the shapes

05 Create cavities throughout the model using the DynaMesh option

06 Modify the cavities while paying attention to the views and smoothing the surfaces as edges

07 Give shapes to the mandible and subtract objects

Useful tips for sculpting in ZBrush

When adding and subtracting meshes from a model, try converting the sculpting to DynaMesh mode. Previously you couldn't subtract any shape from the model without converting it, but with DynaMesh you can use the Blur option to smooth edges as surfaces. I find this is really useful whenever I'm combining an object between the edges. A quick way to convert the application mode to DynaMesh is to hold Cmd/Ctrl-click, then drag and drop on the background. This will be subject to the previous resolution assigned.

05

05 Make the cavities

Now convert the model to DynaMesh mode and deactivate Symmetry. I've chosen to use an approximate resolution of 400 with a Blur value of 0. Now we can apply the InsertCylinder brush to subtract from the sculpt. While applying the brush, hold Opt/Alt to subtract from the mesh. This saves a lot of time going back and forth to the ZSub option. Apply the brush all the way through the model to carve out the mouth cavity and the mandibular notch, as shown in the image. After this we can release Opt/Alt, then adjust our inserted shape by using the Scale, Rotate and Move options under the Transform menu. Next hold Cmd/Ctrl-click, then drag and drop twice on the background.

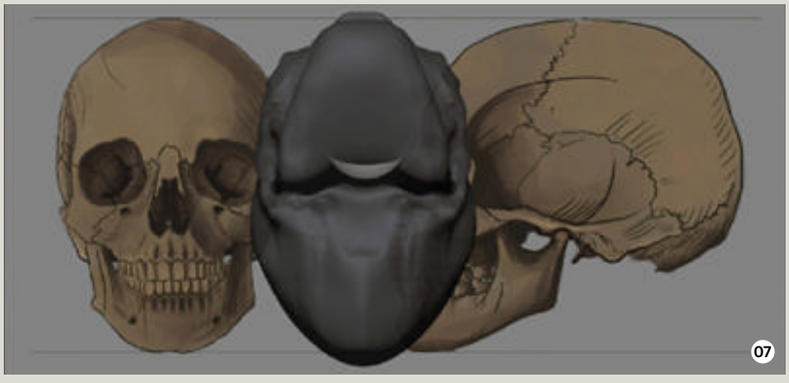
06 Define the edges

Once the cavities are shaped out, we need to redefine the edges of the mandible and reactivate the Symmetry option. In this case I start sculpting with the brushes (Clay Buildup or Standard) used previously. Using the Opt/Alt key to subtract from the mesh will help when you have to sculpt with the Smooth brush. Also try subtly flattening the model's surfaces by carefully applying the Polish brush.

07 The mandible's cavity

To start with the cavity of the mandible, we'll use the same method of subtracting objects as mentioned in Step 05. Insert an object through the mandible (InsertSphere), but be careful just to go through the mandible and not through the skull. This is because we will later be altering the interior of the palate.

06



07

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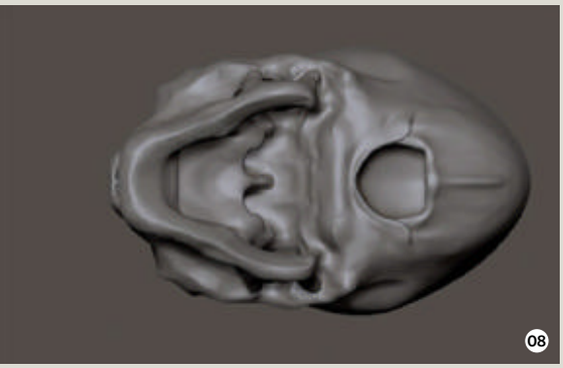


Authentic reference is the key!

I recommend using various reference images from books on human anatomy or the internet. This enables you to get all the different angles and sides accurate, because you can find all the little nuances that can be included. Sometimes you may need to get a real bone to follow the details perfectly, such as faceted angles. A real bone can be rotated so you can appreciate its finer points. Small details like these can be learned when you try to sculpt from images of real bones. Getting a feel for the texture is also crucial.

08 Detail the palate, mandible & edges

Now we can try to refine the skull from the bottom view. This aspect will only improve with practise and by studying skull references from all angles. As we are mainly focusing on the front and side views, by applying the techniques in the previous steps you can create the bottom of the skull using brushes (Clay Buildup or Standard) with Stroke>Freehand set. In this particular case we'll need to rotate the skull to get a good view from all sides, so I recommend activating Alpha 50 while sculpting and following the references.

09 Sculpt the teeth

Save the skull as a Tool and create a new document using the supplied image (Reference Skull.jpg) or another image of teeth that you may prefer. Add a cylinder or sphere, then change this primitive shape to a Polymesh object. At this stage we can increase the subdivision levels to better approach the sculpting. Select the Move brush to get an approximate shape for the first tooth and then start to model it. When the tooth is done, go to SubTool>Insert and add what you've sculpted. You can then do the same for the rest of the teeth.

10 Insert the teeth

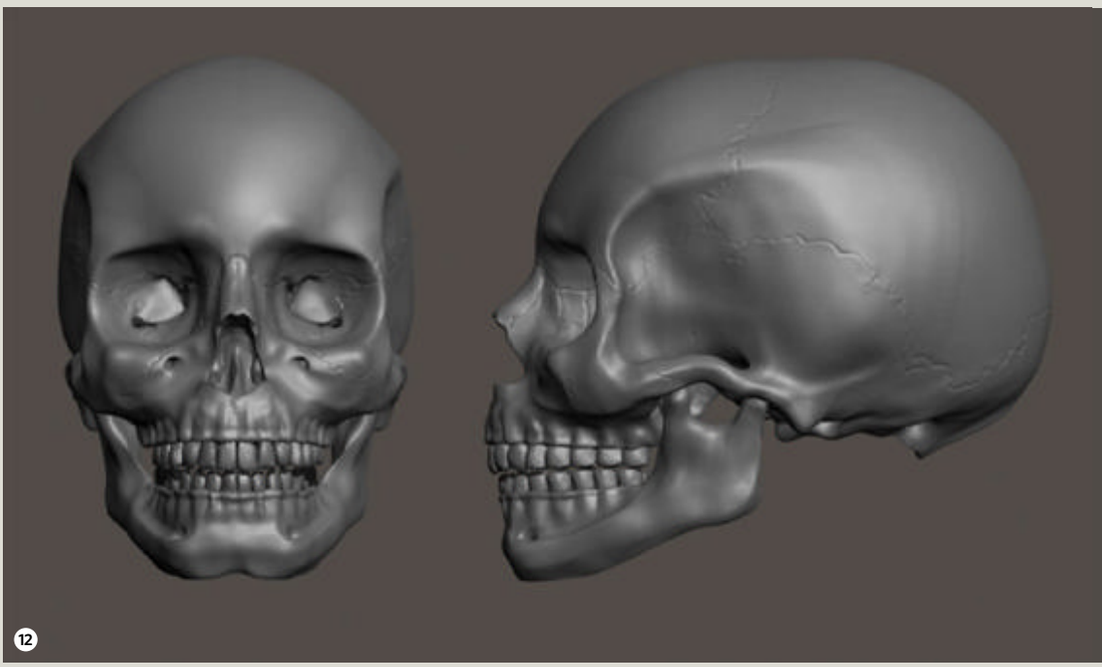
Once all the teeth are finished we'll need to insert them into the skull. For this step, save them as a Tool by going to Tool>Save as and name it 'Teeth'. Open the Skull tool we created earlier and choose the reference image being used as the background. Go to SubTool>Insert and choose the Teeth tool. After inserting this, try to adapt the size to the mandible and make any other changes that you feel necessary. Checking the symmetry is very crucial at this stage.

11 The maxilla & mandible

Maxilla and mandible are the technical terms for the areas overlying the teeth, which produce some irregularities in the bone. To sculpt these, we must use the Standard brush with Alpha 50 activated to control the brush size. I highly recommend taking into account the Z Intensity of the brushes at every step of this process. If you use a high level of intensity it won't enable you to work as you'd wish to and your results will be slightly obscured. While still using the Standard brush, try building up the small irregularities in the skull and over the teeth, as you can see in the screenshot.

12 Apply the final details

To finish the model, we now need to create the subdivisions in the skull to get an even higher level of detail. We can begin by adding these subdivisions using the Standard brush with a small size and the Alpha active (I'm using Alpha 59). Be sure to apply with a low intensity, but feel free to activate any other Alpha that you feel could work better. If you find that the subdivisions you've made are too big, a good tip is to use the Pinch brush to close or approximate the lines.



08 Hollow out the mandible, palate and the bottom of the skull

09 Sculpt the teeth and bear in mind the symmetry between them

10 Place the teeth where they belong and try to adapt the shapes

11 The roots of the teeth have a certain effect on the mandible and maxilla bones

12 The subdivisions of the bones that make up the skull are important for achieving a truly detailed result

• **DID YOU KNOW?** • All tutorial files can also be downloaded from: **www.3dartistonline.com/files**

3DArtist

Back to basics

Ross Board details his industry standard workflow for fast-and-friendly arch-vis renders

The workflow we'll look at here enables an image such as this to be completed from start to finish in less than a day

With the Disc

Tutorial files:
- Tutorial screenshots

3ds Max, V-Ray, Photoshop

Master arch vis in 3ds Max

"Create a dynamic dusk scene with stunning glass effects"

Architectural visualisation can often be a time-consuming and laborious process, especially for inexperienced artists. Images can become stuck at various levels of completion, only to be followed by inevitably long (and very often unproductive) periods of frustration.

Here we'll demonstrate a staged workflow that enables artists to put together a dynamic image in very little time. We'll discuss the principles surrounding various professional techniques, including modelling, lighting, rendering and post.

This workflow lends itself very well to competition pieces, in which an architect would commission a series of evocative images to submit as part of a bid. Jobs such as these tend to be heavily constrained by time and are often very changeable, with designs typically evolving right up until submission deadlines. This is usually dealt with by strategically producing render passes and layering elements in post-production. This means the last-minute addition of a bouquet of flowers behind a large glass wall wouldn't require a timely re-render of the entire image, for instance.

To begin we'll be using a simple sketch, illustrating the intended composition – a rough biro drawing will suffice. Try to use basic photographic techniques, such as the rule of thirds, while searching for a real-life image to act as a stylistic, colour and lighting reference. Having these elements in place from the start will assist no end when it comes to the finished product.

Once this concept is firm, the next step is to progress to the modelling stage. Consider the camera lens that would be required to achieve the shot illustrated in your initial sketch and position a

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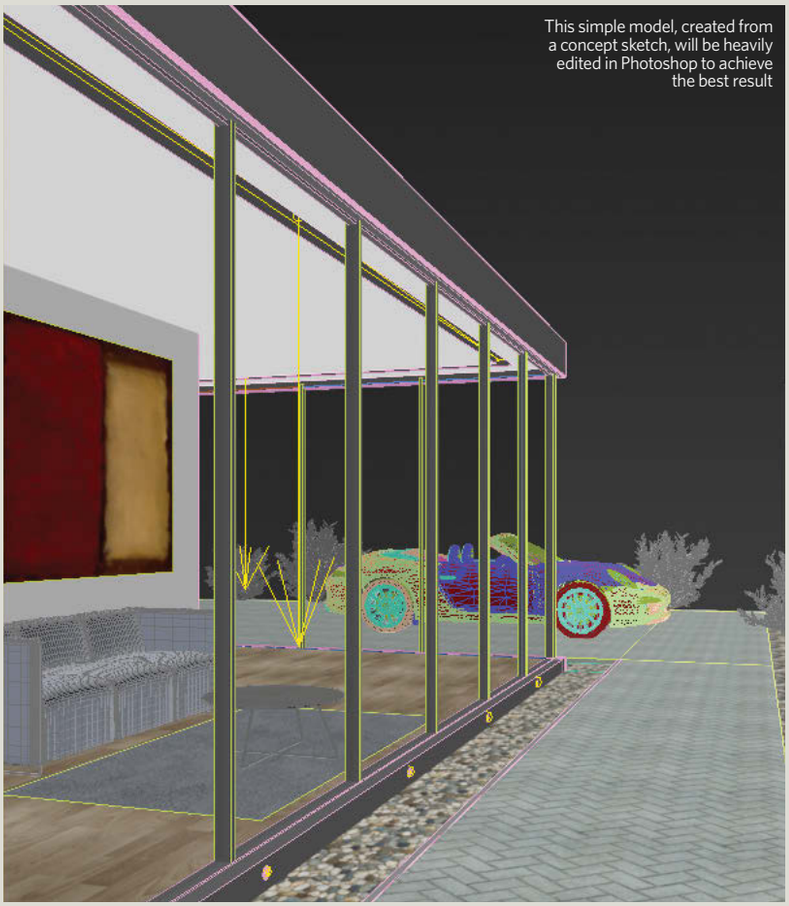
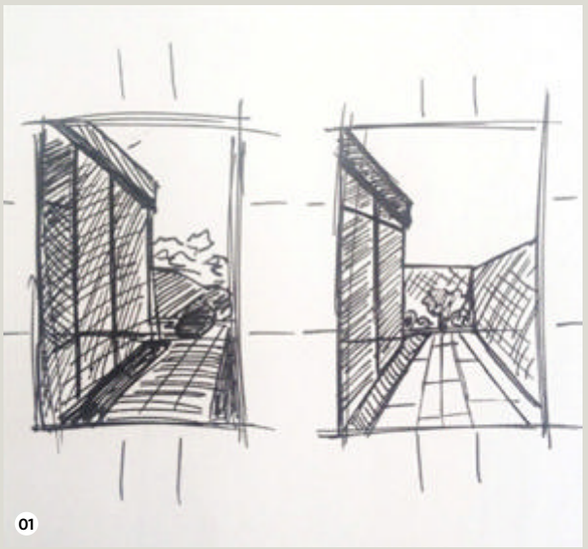


This simple model, created from a concept sketch, will be heavily edited in Photoshop to achieve the best result



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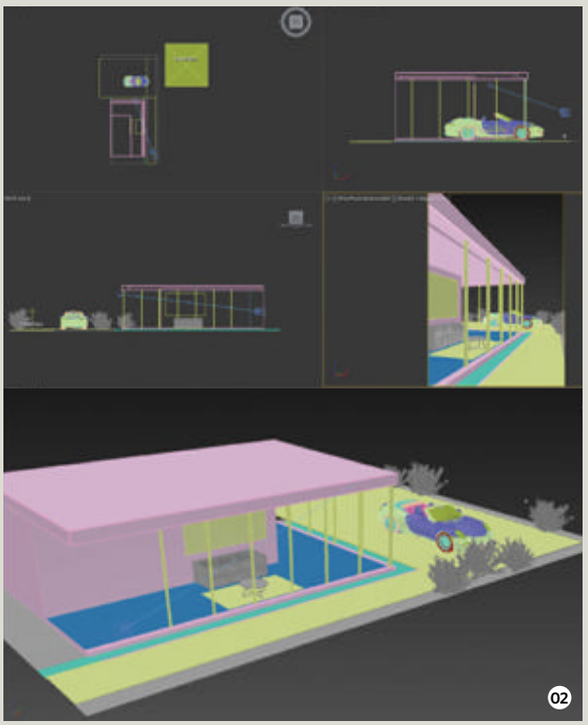


02

VRayPhysicalCamera accordingly. Be sure to use real-world scales while modelling as this aspect could cause all manner of headaches at later stages if it's incorrect. Typically, a 50mm lens positioned at 1,700mm above the ground makes for a good starting point.

When the modelling stage is complete, we will assign materials and establish a very simple lighting setup to achieve a relatively neutral render. However, all of the glass elements will be hidden from view at this point (for later production). This will give a relatively solid base from which to begin loose post-production. We'll establish the look and feel of the image at an early stage and subsequently adjust the lighting and composition to suit.

To finish the scene we will spend some time rendering out the glass as a separate element and compositing it into the final image, discussing the principles of materiality and a few practical tricks along the way. It's worth stressing that this is not a workflow for 3D purists, but more a technique for creating a dynamic image that can quickly support client-driven changes. It's an industry-standard workflow for most arch-vis studios and frees up more time for creativity as opposed to endless technical optimisation.

From sketch to render

01 Find reference

Take time to sketch out some ideas. These can be incredibly rough and should take into account initial compositions and materiality. Begin to visualise the look and feel of the end product and browse for an appropriate real-life reference image. A great reference will really help throughout the process, enabling enhanced photorealism when considering lighting and tones.

02 Modelling from sketches

Use the initial visuals to make a rough appraisal of the required camera parameters (wide-angle zoom lenses and so on), then place a VRayPhysicalCamera accordingly. Here we've used a 50mm lens set at 1,700mm from the ground (head height). This is a decent starting point for most architectural images. Ensure the scene's scale is correct and begin to translate the original sketches to the model. Focus on the camera viewport and be prepared for some tweaks to accommodate the imperfect nature of your drawing.

03 Create materials

Once you're content with the initial model, begin to apply simple VRayMtls. I'm using a

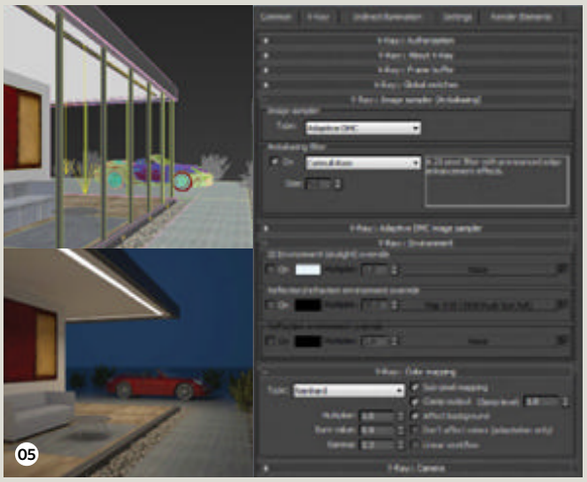
The beauty of post-production

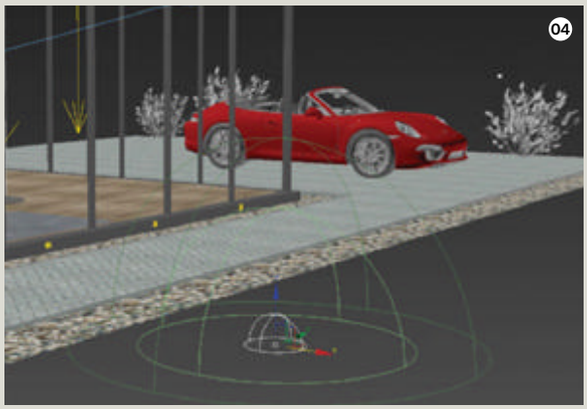
While this approach is fast, it's only one way of achieving effective arch vis. For truly perfect and physically accurate results a significant amount more can be done within the software, leaving renders that require barely any post-production work. To achieve this level of rendering Nirvana, significant time is required, with the final ten per cent taking potentially ten-times longer than if you were to do it in post-production. While quick and 'dirty', the technique demonstrated in this tutorial is usually the more commercially viable option for those with time constraints or changeable clients.

01 The lost art of sketching before starting a project is a valuable step, ensuring that no time is lost due to lack of direction

02 An incredibly simple scene based on initial sketches. There's no need to focus on fine details at this point

3DArtist Back to basics





number of free textures from CGTextures.com to create key surfaces, including a timber floor, pebble surface and concrete brick flooring. All the materials have a slightly exaggerated Reflectivity value to give the illusion of being slightly damp. This is a common trick used to accentuate highlights and details in low-light photography. Here we've also created a Displacement map for the pebble area and applied it via the Displacement Channel in a typical VRayMtl. It's also worth playing with the VRayDisplacementMod to further enhance the results.

03 Use basic materials with large Reflectivity values to replicate a moisture effect

04 Add basic lighting and adjust the Exposure settings to prepare for a base render

05 Set up V-Ray and render an image with passes

06 Open the resulting images in Photoshop and establish a sensible layer/group structure to work from

07 Select suitable imagery and begin to layer distant elements

04 Light the scene

In order to light this scene quickly, we've used a V-Ray Dome light (with an approximate colour to suit a dusk sky) coupled with two high-power Plane lights acting as interior halogen bulbs. Again, this is fit for our purposes in this example, but depending on the intended visual outcome it may be worth using a VRaySun/Sky system or an appropriate HDR sky to add a subtle or directional light. Select the VRayPhysicalCamera and adjust its Exposure settings accordingly to suit the lighting scenario. For this image I'm using f/2.8, ISO100 and a shutter speed of 1/180th of a second.

05 Produce a base render

Now set up V-Ray using typical draft settings, which in my case is an Irradiance map, Light cache, Adaptive DMC sampling, Catmull-Rom anti-aliasing and Reinhard colour-mapping with Gamma set to 2.2. Should the above settings not mean anything, I would recommend investigating Subburb Software's SolidRocks plug-in (http://solidrocks.subburb.com). SolidRocks is a shortcut plug-in for V-Ray, which optimises settings and loads the best presets at the click of a button. Render your scene at full resolution with all appropriate passes (VRayReflection, VRayRefraction and VRayWireColor, typically). Ensure all the glass elements are hidden at this stage.

06 Begin the initial post-production work

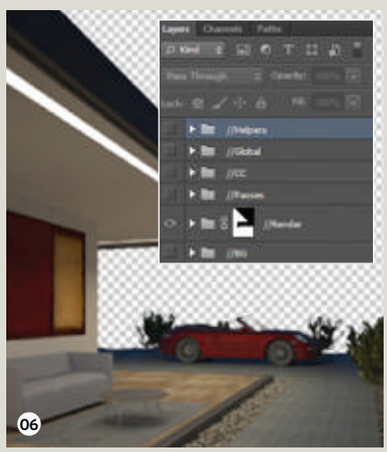
Now open the resulting render and passes in Photoshop and begin to establish a layer structure to work from. Usually it's advisable to work in groups, beginning with the background (or //BG) group and working upwards to: Render, Passes, CC (Colour correction), Global (overall finishing effects) and Helpers (reference images, VRayWireColor pass). Place the raw render into the Render group and use either an Alpha or VRayWireColor pass to select the sky created in the original render. Now apply this to the render group as a mask.

07 Add a backplate

One of the most important elements when creating an arch-vis scene like this is the selection of an appropriate sky or backplate. Try to use your chosen reference image as an indicator to find high-resolution imagery. Place and scale your chosen sky image into your scene, then tweak the background using Photoshop's various adjustment layers. Now you can begin to layer on additional elements, such as distant trees around the horizon line and so on.

A layered approach

By using an approach that enables the compositing of various layers, we are able to gain greater control of elements and process images in a staged manner. Applying the glass as a separate element not only grants the ability to modify its effect, but also to add things under it – negating the need for a timely glass render.



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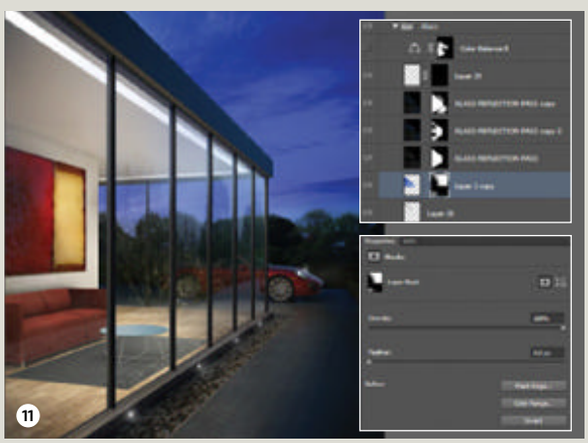
08 Correct the tones

Now begin working on elements of the image so as to match your reference, typically using Curves, Color Balance and Hue/Saturation layers where necessary. This is best achieved by focusing on larger elements and then narrowing down to finer details. It can also be helpful to concentrate on certain areas (such as the exterior). Here we've used the VRayWireColor pass to make all of the selections necessary for editing. It's worth noting that this can generate slightly noisy edges and must be monitored closely.

09 Prepare glass in 3ds Max

The scene is now at a stage where it's necessary to include glass. As we didn't render this in the initial passes, reopen 3ds Max and reveal the glass elements ready for production. It's important that the glass should have something to reflect (as falsifying this later is challenging). To achieve a reasonable base reflection, place a large plane with an appropriate image mapped to it within the proximity of the glass. Bear in mind that the angle of incidence equals the angle of reflection, so be sure to position accordingly. We've used a tree line coupled with a corresponding Opacity map, though this could be achieved using 3D geometry.



10 Render the glass

Next, adjust the material settings for the glass (see screenshot) and render with the same passes as mentioned previously (VRayReflection, VRayRefraction and VRayWireColor). Now add the pure reflection pass into the working Photoshop document and use a mask to ensure only panels are visible.

11 Blend the glass layers

Set the glass reflection layer to Screen blending mode and adjust it to suit. This could involve manipulating its Curves to achieve more contrast in the reflections, for example. Remember that glass reflects more at acute angles (the Fresnel effect) and will never reflect brighter than its surroundings, so don't push things too hard. Add a touch of colour from the brightest point in the sky backdrop and blend to suit.

12 Global colour correction

As a final step you can begin to tweak the entire image, making large creative edits. Add vignettes, overall colour modifications and attempt to make the image pop as much as possible. This is known as the global adjustment phase and will typically bring together all of the elements, providing the basic adjustments are in sync. Now is also a good time to experiment with creative cropping to focus the eye on specific parts of the image.

---

08 Use adjustment layers to modify the colour and tonality of the rendered image, so as to suit the reference image

09 Reveal all the glass elements. You need to ensure there's enough context left in which to produce a decent reflection

10 Render the glass and then merge a reflection pass inside Photoshop

11 Blend the glass layers and adjust the tones to suit the backplate

12 Make creative tweaks to the image to ensure continuity and maximum realism

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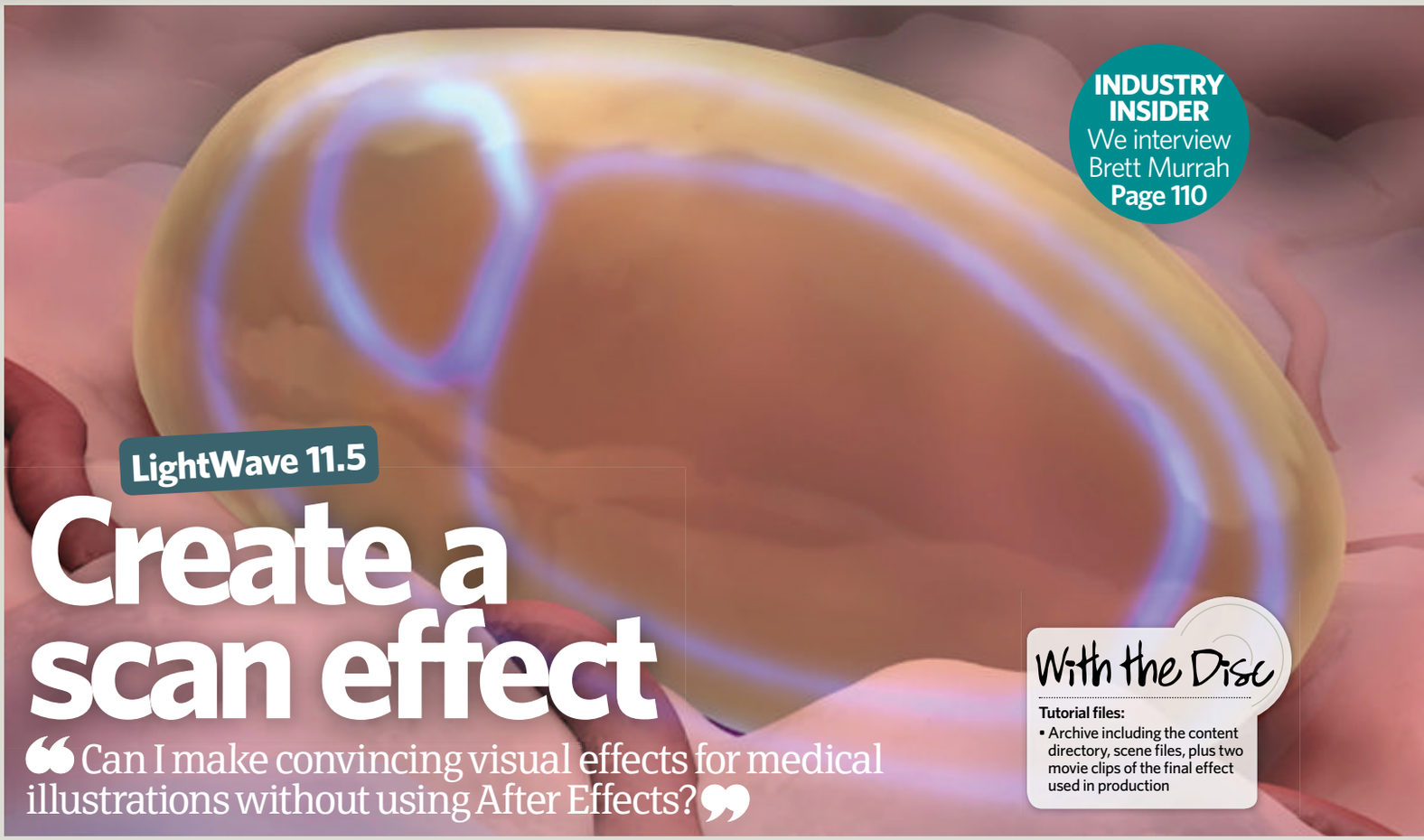
LightWave
Brett Murrah
www.xvivo.com

Brett is lead medical animator at XVIVO Scientific Animation and has been working as a 3D and VFX artist since 1996. He currently lives in Connecticut, USA

CINEMA 4D
Magyar László
www.laczadesign.com

Magyar is a designer and artist from Hungary and has been working in graphic design for six years. He's always seeking challenges and ways to create new ideas



INDUSTRY INSIDER
We interview Brett Murrah
Page 110

LightWave 11.5

Create a scan effect

"Can I make convincing visual effects for medical illustrations without using After Effects?"

With the Disc

Tutorial files:
- Archive including the content directory, scene files, plus two movie clips of the final effect used in production

A while ago I had a particular project where a client asked for a scanning effect, such as a simple scan that runs through an object on it's X, Y and Z planes.

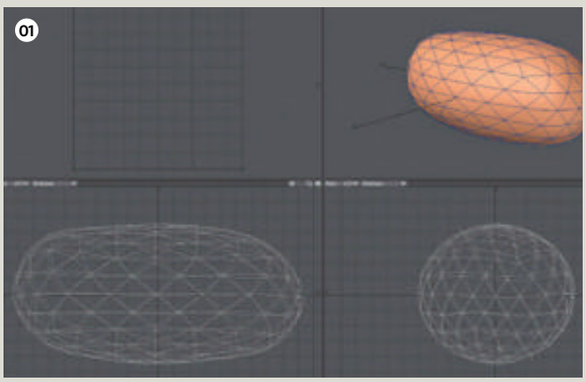
3D objects are usually hollow and have no thickness, so one of the first challenges was that the object needed to look like there was material inside and that it had a certain thickness.

The second challenge was that this needed to be a 3D effect and the camera needed to be constantly moving around the object. This meant I had to come up with something using LightWave, render it out and not rely on After Effects or any other type of a plug-in.

I immediately tried some surface tricks and animated texture maps, but nothing was working to my liking. There are some clip-map tricks I know of, but these didn't match what I was looking for either. What I needed was a thin slice of the object, but something with randomness to it – a result similar to a boolean effect – to show what shapes were inside the object.

I decided to give HyperVoxels a try and see if they would produce the right result. I found that if I took my original object (which resembled a hollow elongated sphere) and saved other geometry inside it, I could apply HyperVoxels with some other tricks to help get what I needed. I was then able to move the entire effect by using simple Null objects and a black-and-white image to key out what I didn't want to render. This was a huge advantage, as I could choreograph my camera movement with the timing of the reveal of my object. This effect can easily be applied to any object by simply replacing the main object that receives the HyperVoxels.

This tutorial will show how you can create a similar outcome to wow your clients, although I'd love to see someone push these techniques even further still!



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KeyShot Pro

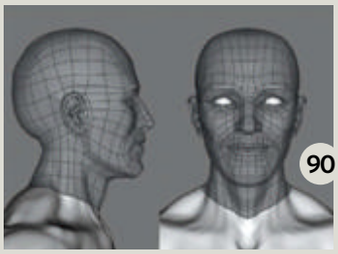
Craig A. Clark
www.scorpiocgi.co.uk

Craig is a hard-surface modeller with over 12 years of industry experience. He has worked for a range of media including film, TV, music videos and videogame projects

TopoGun

José Alves da Silva
www.artofjose.com

As a freelance 3D artist and illustrator, José specialises in character design, sculpting, modelling and texturing. He works in the games, film and advertising industries



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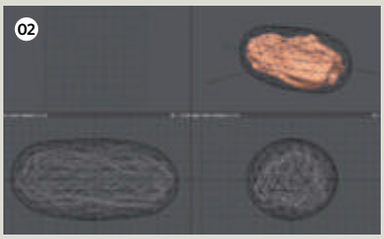
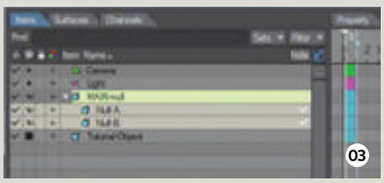




01 Create the object

In LightWave Modeler, create a four-segmented tessellated sphere with the dimensions: X: 2m, Y: 1m and Z: 1m. Hit Tab to make the sphere a subdivision sphere, then make a copy of this new sphere and paste it into a new layer. You can now view your object and the first copy of your sphere using the Background>Layers tool.

02 Make adjustments

Scale your new copy so it fits inside the original sphere using the Size or Stretch tools. Now use more tools, such as Jitter, to make your inside layer object rough and organic (your inside shape can be anything you'd like: multiple shapes, smooth shapes and so on). In this example I'm using the Jitter tool to roughen the points of my object up. Now the object should look a little like what you can see in the screenshot. Make sure both objects are put into one layer, then save your object and send it to Layout. I've decided to save mine as 'Tutorial-Object.lwo'.

03 Set up Layout

Open Layout and load your new sphere object. In the Display Options, set your Display to Bounding Box. Now build three Null objects to better control the effect. Add/Build a Null object and give it a name that stands out, such as 'MAIN-NULL'. Create two more Null objects – I've named mine 'Null-A' and 'Null-B'. With all three Null objects at 0,0,0, parent Nulls A and B to the MAIN-NULL. Now move Null-B to have a Z value of -50 mm, so it's just in front of the other nulls. Null-A and the MAIN-NULL should still be at 0,0,0 at this point.

04 Add HyperVoxels

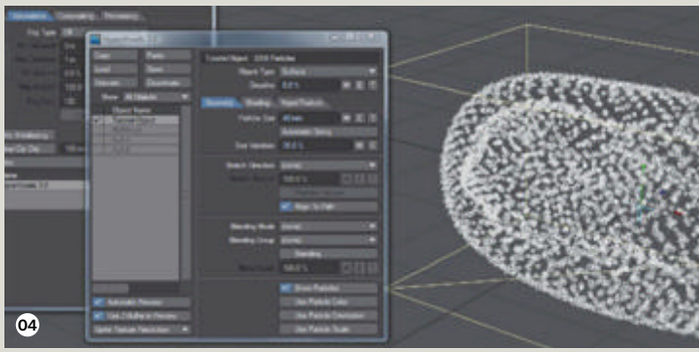
Add HyperVoxels under Effects> Volumetrics, then open HyperVoxels and activate your sphere object. This will add a HyperVoxel to every point of your object. The original sphere, plus the inside shapes, will all receive this effect. Keep the Object Type set to Surface and use roughly 40mm for the Particle Size. You can play with Size Variation if you want to. For this tutorial I'm using about 35%, just to add some randomness. Activate the Show Particles checkbox to see the rough shape the HyperVoxels will be when in Layout.

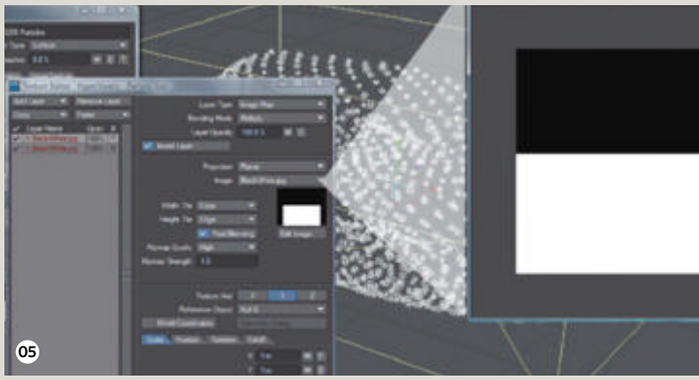
05 Refine the effect

To create the slice layer within the HyperVoxels I find that using a simple black-and-white gradient works best. By linking each of the A and B Nulls to this gradient, the effect can be keyframed and made wider interactively. Begin by clicking the T button next to Particle Size, then apply your black-and-white JPEG image as a Planar Y-axis image. For a reference object, pick Null-A and switch the Width and Height Tile to Edge for both. Copy and paste this layer on top of itself, but be sure to change this top layer to Invert Layer and set it to Multiply. Also ensure you change this layers' reference object to Null-B.

06 Finalise the FX

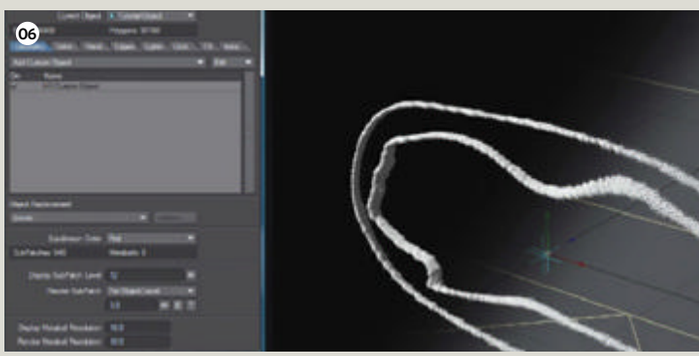
Now all that needs to be done are some linear keyframes, such as the MAIN-NULL, which is the parent of the other two Null objects. At frame 0, give it a keyframe at 1.2m on the Z axis, then go to frame 30 and keyframe it at -1.2m on the Z axis. Scrub through the animation and you can see a very rough version of your effect. Now select your sphere object and view its Object Properties. If you change the Display SubPatch Level to 8 or 12, you will see the desired effect of a slice of your object. If you hide your object in the render, all that will render is the HyperVoxels slice of your object. The effect can then be keyframed and rotated to get slices out of different directions of your object.





If Layout slows down...

To get a nice look for your objects, try turning up the subdivision level to a higher number. A tip for working with this effect is to preview and time out your shot with a low subdivision level – around 2 or 3 – and raise the level for the final render. Using a low subdivision level will help to scrub the timeline and keep things more at a real-time viewing during your testing. This means you can work and still see the HyperVoxels in OpenGL inside Layout and get a ring effect of slicing through your object. Bring this into your favourite compositing program to overlay the effect on top of your object and get a neat blurry – or MRI-like – scan. If you adjust the reference Null object, Null-B, you can then make the effect thicker or thinner.



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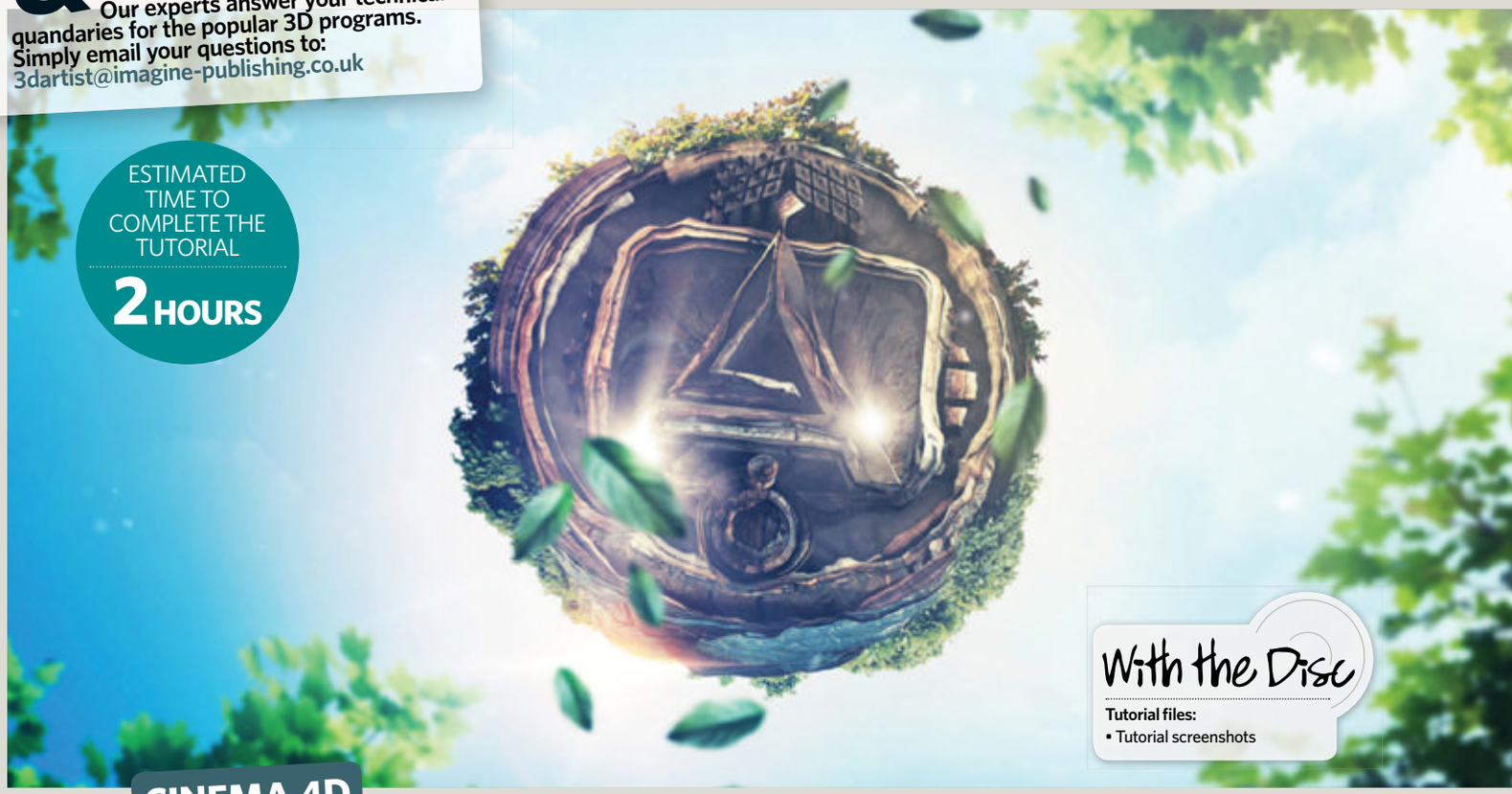
2 HOURS



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Tutorial files:
- Tutorial screenshots

CINEMA 4D

Texturing tricks

"I need to create some typography with a wooden effect. How can I do this in CINEMA 4D?"

I'm going to outline the workflow I used for an entry I made to last year's Desktopography project. I'll try to offer a detailed explanation of how to create a realistic bark effect through several steps, and hopefully you'll discover how to bring an artistic feeling to your fresh renders as well.

I usually render my artwork out at a resolution of 2,560 x 1,440 pixels and at 300dpi, which is adequate for general use. You can use these settings or choose your own. You'll also need to gather a few suitable images to work with – I'm using some great free textures from CGTextures.com, as they're okay for commercial use.

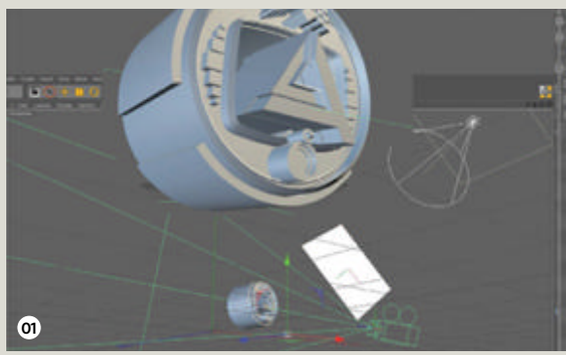
The inspiration behind my piece here is nature. When I began the project I hadn't tried anything like it before, so I basically just went for it. By surprise, it's become one of my most successful pieces.

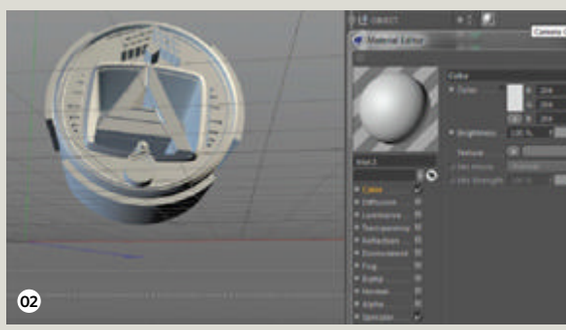
For this tutorial you'll need a working knowledge of Photoshop and you should also be fluent with a 3D modelling application, such as CINEMA 4D, which is what I'll be using here. I recommend CINEMA 4D to those new to 3D graphics as I have personally found it to be the easiest 3D software to learn, so far. The techniques I'll be demonstrating will be completed using the most basic tools within CINEMA 4D, but you should be able to translate them for other 3D programs, if you want to.

01 Build the model

You're going to need a model to work with. I'm using a simple one created from basic triangular and circular shapes. Most are formed using the Extrude option. For circles, you can use the Sweep NURBS options.

To quickly set up some lighting, I use the built-in StudioB_Environment in the Visualize folder. You'll see I've got a Plane object with a simple Luminance texture too, and I advise using a camera as well. Set the desired angle you want, add a Camera object and apply it. With this turned off, you can move freely in space, but when it's turned on you'll be locked onto your theme.





02 Create texture

My wooden texture is the result of lots of trial and error. I'll save you all this hassle, though, by telling you the exact values in this tutorial. To create the texture, first click the area below the render window twice, then double-click your desired texture and drag it onto the model. Now you can take a good look at all the details.

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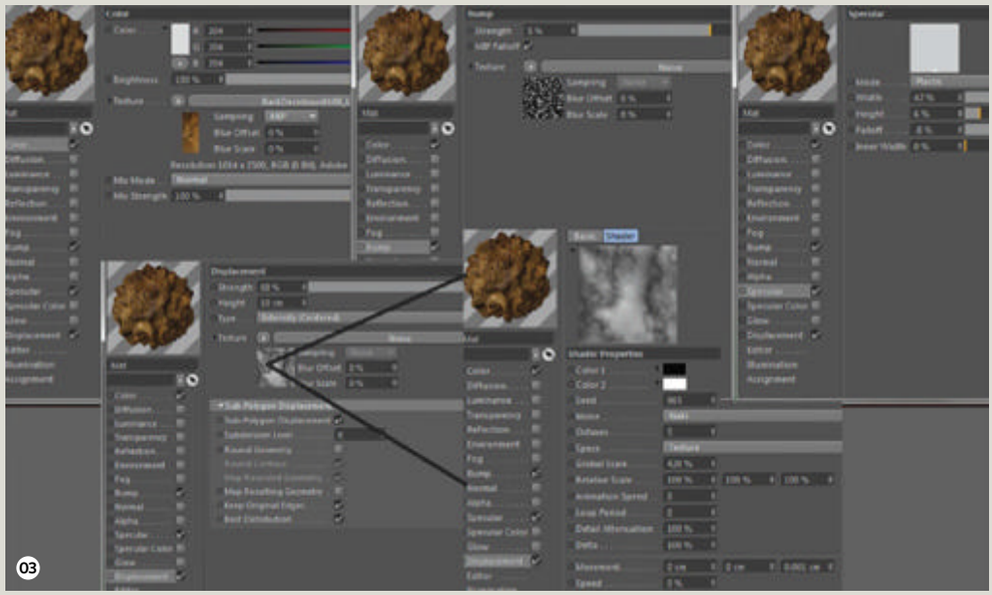

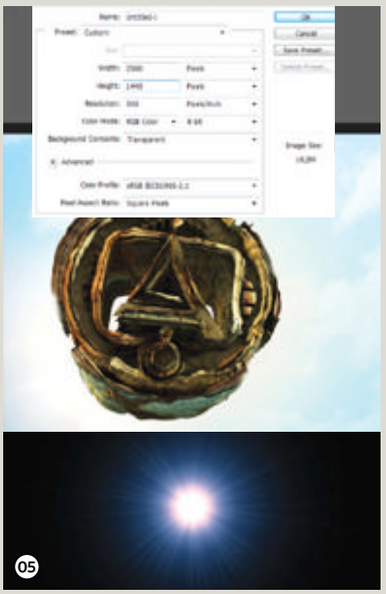

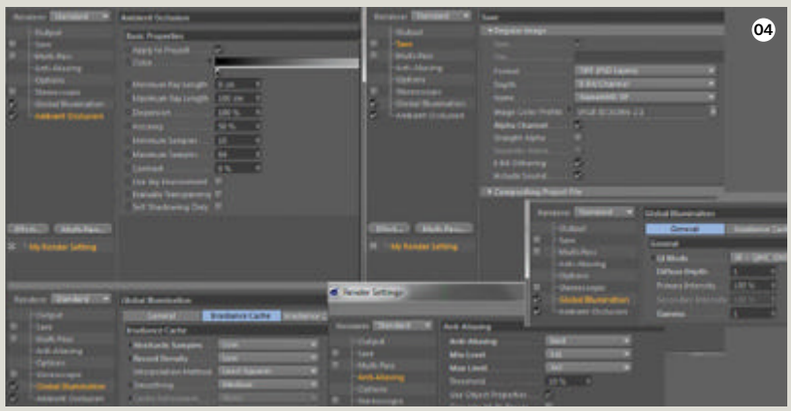

03 Set up the texture

Apply these values on the given layers – feel free to change them to suit your tastes. My settings for the four layers are:

- Color – simply drag the texture here, there's nothing else to do
- Bump – set Noise to Sema 5% and Global Scale to 53%
- Specular – set the sliders to: Mode: Plastic; Width: 62%; Height: 6%; Falloff: -8%; Inner Width: 0%
- Displacement – set Noise to Naki and Global Scale to 420%
- Displacement (again) – set the Strength to 68% and Height to 10cm
- Sub-Polygon Displacement: We want Subdivision Level 6 here

04 Prepare to render

We can now look at finalising the render. In the Render Settings we'll use Global Illumination and Ambient Occlusion. The former has many options, from which we'll use the lowest settings. In the Save menu, tick the Alpha Channel, as we don't want any background to our PNG render. Also use the Best option for Anti-Aliasing.

05 Move to Photoshop

We should now have a raw PNG file from CINEMA 4D. Open up Photoshop and create a file at 2,560 x 1,440 pixels, 300dpi. Fill the Background layer with #b6f9ff, then duplicate this and apply a Gradient Overlay layer effect. Use these settings, or similar:

- Blend Mode: Normal
- Opacity: 100%
- Reverse: checked
- Style: Radial
- Scale: 100%
- Five-way gradient colour codes: #/02102a/06213f/0c3c62/307eae/b4e5f3

Set this layer's Opacity to 44%, then use a cloud layer multiple times and fade it gently. I often also use some lights rendered in CINEMA 4D and then re-colourise and re-blur them in Photoshop. When the background is ready, add the PNG render to the canvas, position it to the centre, then duplicate it and set this new layer to Overlay. I recommend playing with the overall opacity (I use 69%), as this effect gives more contrast to the final image.

06 Image adjustments

Download your chosen textures from CGTextures.com and place them at the corners of the canvas, then blur each of them one by one with the Gaussian Blur. I've used two types of wooden textures in my artwork to give it a more natural look. You can also add some blurred leaves as well. To achieve the final artwork you can use some of Photoshop's adjustment layers, such as Gradient Map, Color Balance and Levels. Make sure you pay attention to each layer's opacity values. For an overall gradient effect, select the topmost layer, hit Cmd/Ctrl+Opt/Alt+Shift+E to create a copy of all the visible layers in the document to the top. Set this to Overlay and play with the opacity to fine-tune the end result.

Textures & tools

All the images used here are sourced from CGTextures.com. Good keywords to use for this tutorial are: wood, tree bark, deciduous... You don't need to use exactly the same images as mine – or even my values.

I've used CINEMA 4D and Photoshop CS6, but you can use your preferred tools. Just remember your goal is to produce the highest possible resolution. To take my images further I also often use – and highly recommend – the Greyscalegorilla Light Kit Pro, created for CINEMA 4D (**http://greyscalegorilla.com**).

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LightWave, KeyShot Pro

Achieve better renders

"How can I increase the believability of my 3D scenes?"

When we begin a project, our goal, typically, is to reach the finish line with a realistic rendered image. While full photorealism may not always be needed, we certainly want our renders to be representative of the subject matter. KeyShot has always had its rapid workflow as a primary key to its success. Its sheer speed at render time has backed this up to provide a pretty knockout solution for producing photorealistic rendering.

However, while not always necessarily a problem, there has been one consistent shortfall in the software that has limited the scope for what could be produced: shadows. We instinctively know where these should lie, but getting their definition correct has traditionally been tricky.

With past versions of KeyShot, lighting was often sourced from HDRI backdrops, often with added luminous geometry. While this gave us appealingly realistic lighting, it also provided muted, blurred and very soft shadows. However, KeyShot 4 has stepped up with a solution to this: we can now include lights in a scene that are additional to any luminous geometry and the HDRI environment.

Strange as it may be, we're currently only able to add lights to geometry in the scene. This presents many pros and cons, but personally I prefer having the option to add lights as their own entities.

On the bright side, the program provides a decent range of lights to choose from. There are two Point Light options: a simple Point Light with Color and Power parameters, or an IES Point Light. Simply load up an IES profile, if you need specific lighting types, and away you go. With Point Lights, the geometry of the material designated as a light becomes invisible, because the source is a point rather than an area of polygons.

The third option is an Area Light, which does use the polygons assigned to the material as the active area of the light. Larger areas of polygons provide more coverage and softer shadows.

Between the three options there's not a lot that can't be achieved and the only gap I've found is that IES Point Lights will only produce sharp shadows.

The following steps will walk you through the rendering of a model using the Environments options and the new lights in KeyShot 4 Pro.

01 Compose the shot

The first step is to set up the shot, so here I have the mechanical dragonfly modelled in LightWave (exported as OBJs) imported and all the materials assigned accordingly.

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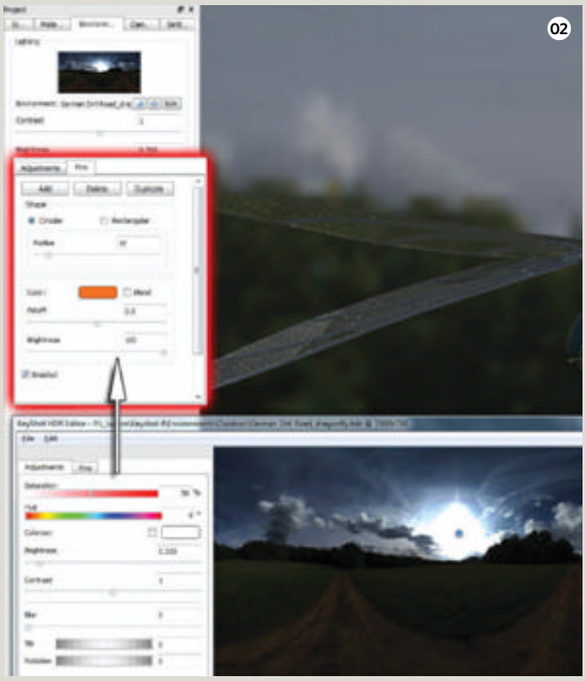
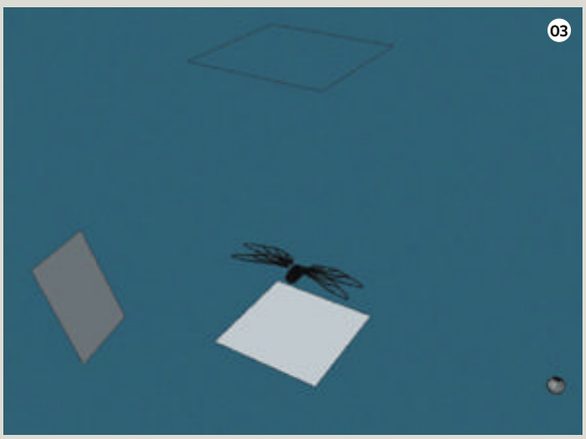
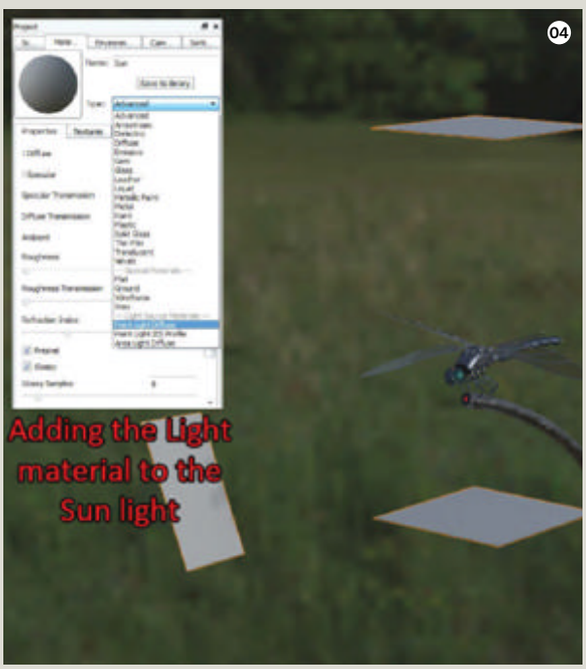






Next I check that I have all the material designations I need before going too far (especially if importing OBJs). I've selected an environment HDR image to be used. In this case a serene country road works well, as this subject should definitely be outdoors and the basic lighting it provides looks pretty decent.

02 Alter the environment

My chosen HDRI map is quite good, but is slightly flat and cold at this stage. So let's warm things up a bit. I open up the new Edit option of the Environments tab and add a Pin (light source). From here I can colour, intensify and position the HDRI any way I like. The new Pin light is orange to replicate the warmth of the sun and I also reduce the brightness of the underlying original image to boost the contrast.

03 Let there be light

I've warmed up the tone of the image and things are looking much nicer, but I still need to bring greater definition to the shadows. Back in LightWave Modeller I load up the dragonfly body and wings for reference, then create a light for boosting the Sun, a fill light, and up-and-down lighting fills. I position these as I see fit, but they can always be moved around in KeyShot.

04 Configure the highlights

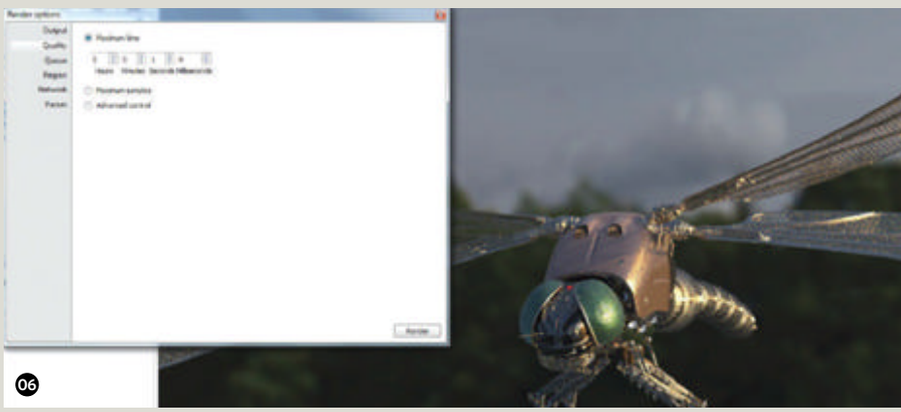
I can now export the lights as an OBJ file from LightWave and import it into my dragonfly scene. Once imported, these are in the correct positions compared to the dragonfly. I also set the Sun up as a Diffuse Point Light to provide some crisp shadows. My fill lights are Area Lights, which you'll notice remain visible and provide options to hide certain attributes. Point Lights are never visible physically because they only have a single point of origin.

05 Reposition the lights

Optimise the position of the lights and place them where you think is best for the shot. You can also model them at world zero and position after importing into KeyShot. The lights can always be selected by the name of the material and then moved as required at any time (I always use the Move tool for this, as the Transform handles make it much easier). The Sun light does actually need to be moved to get the result I'm looking for.

06 Begin to render

Now it's finally time to render out the scene. I always opt for 32-bit TIFF files, including Alpha Transparency, as I find it provides the most flexibility with the output file. Quality options enable you to specify maximum samples, while the Advanced setting defines the individual control of depth of field, sampled, aliasing and so on. I personally find the best solution is to specify the maximum render time. This leaves KeyShot to produce the optimal render it can within the set time.



It's a material world

I use LightWave for all my modelling, so it's important to get the assignment of the surfaces on my models correct. The surfaces I create in LightWave define what counts as an entity in KeyShot, so having a bunch of items all surfaced as Chrome, for example, would make them all a single-joined entity in KeyShot. This means they should be assigned as specific Chrome surfaces in LightWave (or other) to ensure they can be manipulated individually. Get this wrong and you'll find yourself reassigning the export, import and material settings in KeyShot, which could get extremely frustrating!

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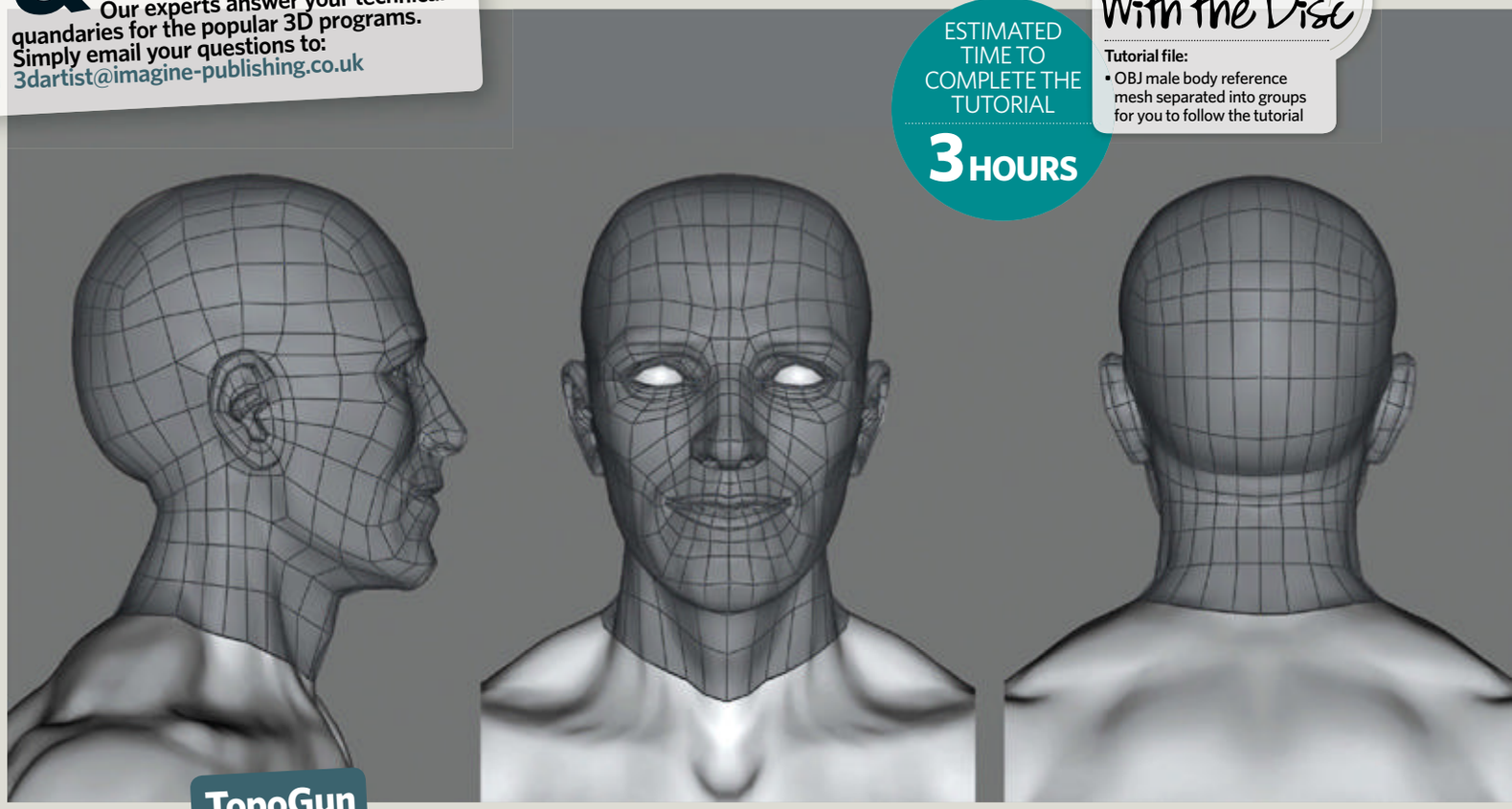
ESTIMATED TIME TO COMPLETE THE TUTORIAL
3 HOURS

With the Disc

Tutorial file:
- OBJ male body reference mesh separated into groups for you to follow the tutorial



TopoGun

Tips for better topology

"How can I best approach the retopology of a character model?"

TopoGun is an excellent retopology software that includes a set of tools ranging from semi-automatic topology to the manual editing of each vertex. It's important to know that the more automatic a process is, the less precision you will get. So, a good general procedure is to use automatic tools to do the hard or tedious work and then manually adjust the result to your specific requirements.

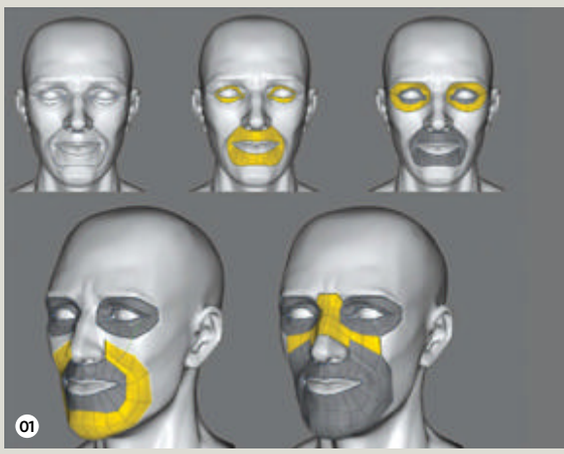
One useful feature of TopoGun is that you can create edges without polygons. These can serve as guides for your retopology approach before creating polygons. Another aspect to keep in mind is that we can divide most of a character's body into simple cylindrical shapes – like fingers, arms, abdomen and legs.

Here I'll explain a retopology sequence for the more complex areas – the head and hands. The logic of this approach can be used on other body parts as well, though. Before importing, you should prepare your reference mesh by separating it into parts that will ease accessibility. In the OBJ (supplied) as a reference mesh, I've separated each finger of the left hand, the arm and the leg. The OBJ's sections will be recognised as groups that you can toggle the visibility of. This will enable you to hide other fingers while retopologising one of them, or hide one leg to retopologise the inner thigh of the other. If you use ZBrush to create the reference mesh, separate it into Polygroups, as each of these will be considered a group in TopoGun.

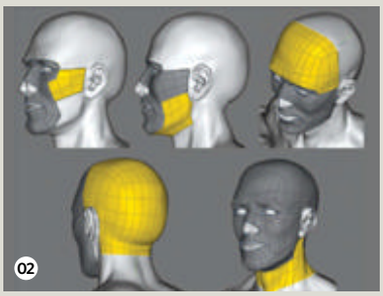
To begin, open TopoGun, go to File>Load Reference and pick the character OBJ (supplied). Click on the Groups button at the top of the screen to open the Groups window, give each group a logical name and you're ready.

01 Use the SimpleCreate tool

Enable Symmetry (X). Use the SimpleCreate tool to click on the surface and create edges (hold Cmd/Ctrl and click to connect vertexes). Use the SimpleEdit tool to reposition the vertexes, then establish edge loops around the eyes (the interior and exterior of the eyelids) and mouth (outer lips, a large loop below the nose and above the chin). Use the same number of vertexes on the top and bottom of the mouth, as well as the eyes, so that they match when closed. Using the Bridge tool (with Faces on), create polygons connecting the eye and mouth edge loops. Select the Extrude tool (with Crawl active),



and pick one of the outer edges of the eye. Press the Loop button to select an edge loop and click-and-drag the green vector on the edge to create new polygons around the eye. Now move vertexes to define a loop that goes below the eyebrow and above the cheekbone. Select edges around the outer loop of the mouth – except the ones below the nose – and drag twice with the Extrude tool to create new polygons. Next, move the vertexes so that the polygons cover the chin and align them around the eye. Now apply the SimpleCreate tool again to connect the mouth and eye areas, and add polygons to build up the bridge of the nose.



02 Extrude & adjust

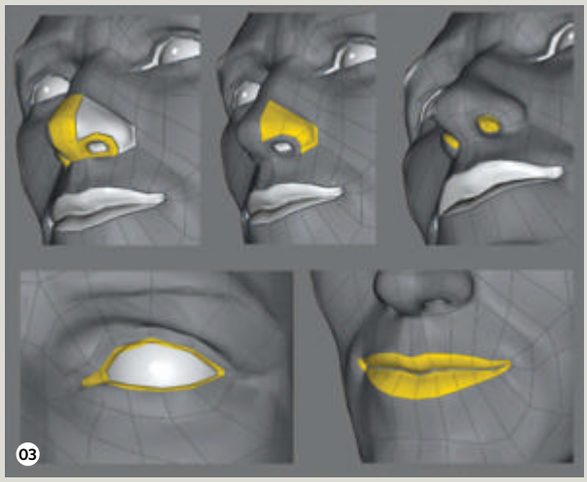
Extend a strip of polygons along the cheekbone towards the ear and down to shape the jawline. Use the Extrude tool to the extend edges above the eyes to create eyebrows and a forehead, then keep using it to adjust the vertexes, building up the back of the head and moving around the ear area to produce an edge loop. Close the gap between the back of the head and the jawline, then extrude again for the neck.

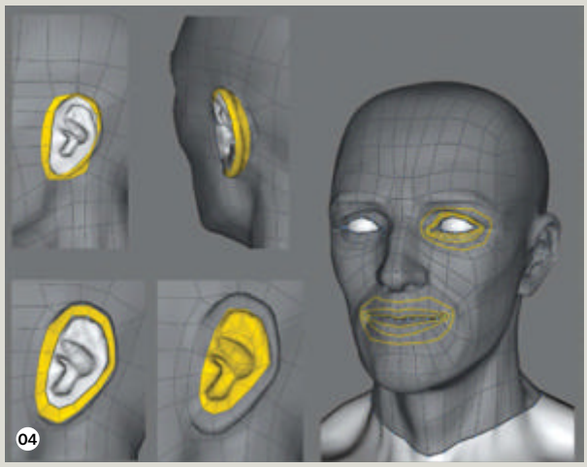
03 Perfect the nose

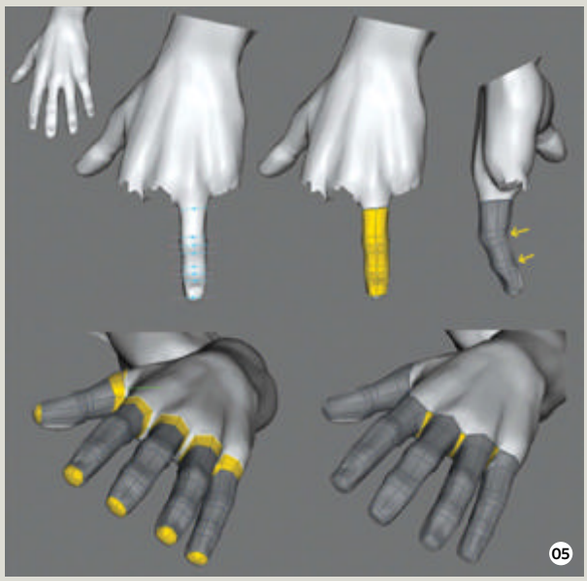
To finish the nose, connect its bridge with the top of the lip and add its tip. Produce a polygon loop around the nostril and add more polygons for the wing. Extrude a loop inside the nostril to provide depth and close it with polygons. Now add a loop of polygons inside the eye, stopping at the intersection with the eyeball to give depth to the lid. For the lips, extrude their outer edge to the inside, leaving a gap at the opening.

04 Time for the ears

For the ear, add an extra loop of polygons around the opening, then create a strip of polygons to cover its edge. Fill the back of the ear with polygons, add an edge loop on the front to create the rim and fill the inside with polygons. Topology inside the ear isn't very important for animation, as ears don't deform much. If you need more detail, just add loops by changing to Sym Selection, selecting an edge, using the Connect Ring button and adjusting vertexes. You can also add extra loops around the eyes and mouth.







Tips for quicker retopology work

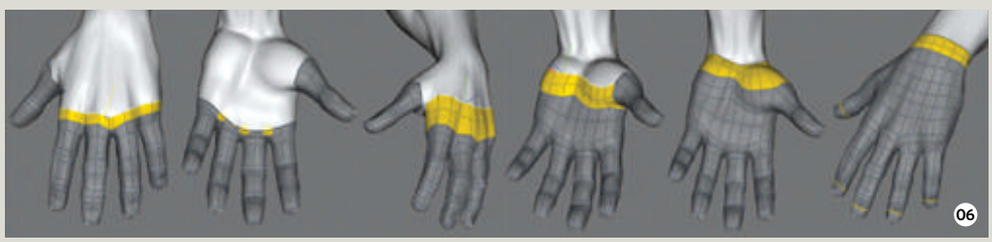
- Ctrl/right-click to alternate between the Edit and Create tools
- Split your reference mesh into groups
- Use the F key to orbit the camera around a selected area
- Use the Tubes or Draw Sweep tools to retopologise cylindrical forms
- Use the Extrude mode to pull new polygons from existing edges
- Retopologise the main form with a few polygons, then subdivide to add detail
- With the SimpleCreate tool, enable Make Faces to create new polygons
- Use the Bridge tool in Faces mode to create polygons between near edges
- Select Connect Ring to add edge loops perpendicular to a selected edge
- If you get reversed normals, select vertexes and click Force Refresh to realign the normals

05 Take care of your hands

Disable Visibility under Groups for everything except the arm and one finger. Viewing the finger from above with the Tubes tool (eight divisions), drag to create a section line at its base. Create sections along the finger, marking the knuckles and an extra section on each side of the joint, as well as the tip. Now Ctrl/right-click to generate topology and draw the sections in order, from the base to the tip. Adjust the vertexes on the other side of the finger to match the knuckles and repeat this for the rest. Now create a vertex at the tip of each finger and connect them to the surrounding vertexes to close the tip with four polygons. Select an edge at the base of the fingers, use the Extrude tool to grow fingers towards the hand and add polygons between them.

06 Get those fingers right

To finish, extrude an edge loop near the fingers, then weld the polygons' vertexes together between the fingers on both sides of the hand. Extrude twice more to produce polygons along the hand and adjust the vertexes so that the side of the index finger's edges match the side of the thumb. To finish, you can adjust the vertexes to follow the padded areas of the palm, extrude the wrist and weld some vertexes to reduce the poly count along the arm.



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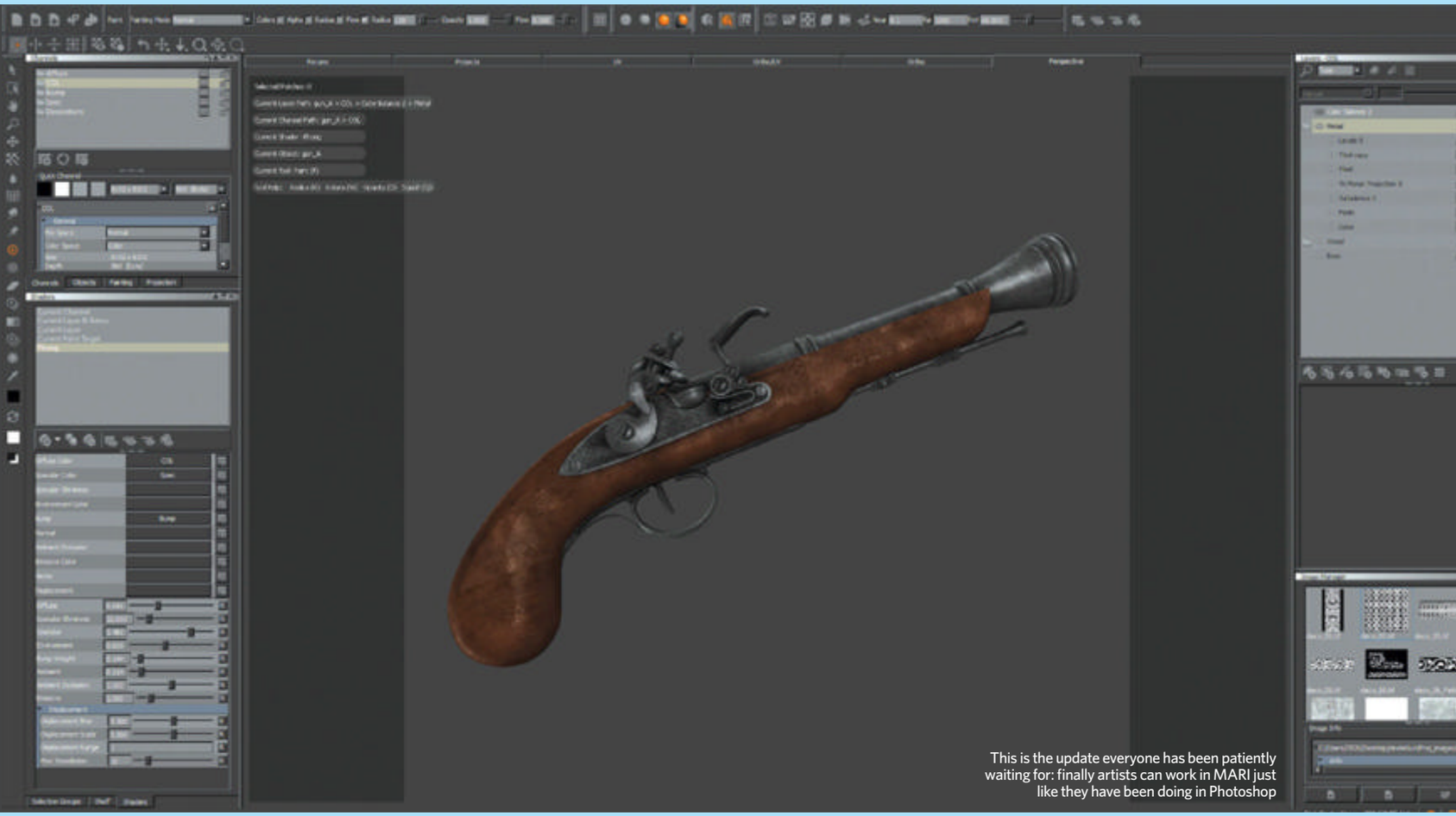


This is the update everyone has been patiently waiting for: finally artists can work in MARI just like they have been doing in Photoshop

MARI 2.0 £1,210 / $1,995 US

With its new Layers system, this exciting new version will feel even more familiar to users coming from a 2D texture-painting environment

REVIEW BY Daniele Orsetti, texture artist and modeller at MPC, UK

MARI is 3D texture-painting software originally developed at Weta for Avatar. The Foundry acquired it around three years ago, and since then it has become the new industry-standard for 3D texturing, being notably used in nine of the 10 feature films shortlisted in the 'Visual Effects' category at the Oscars this year.

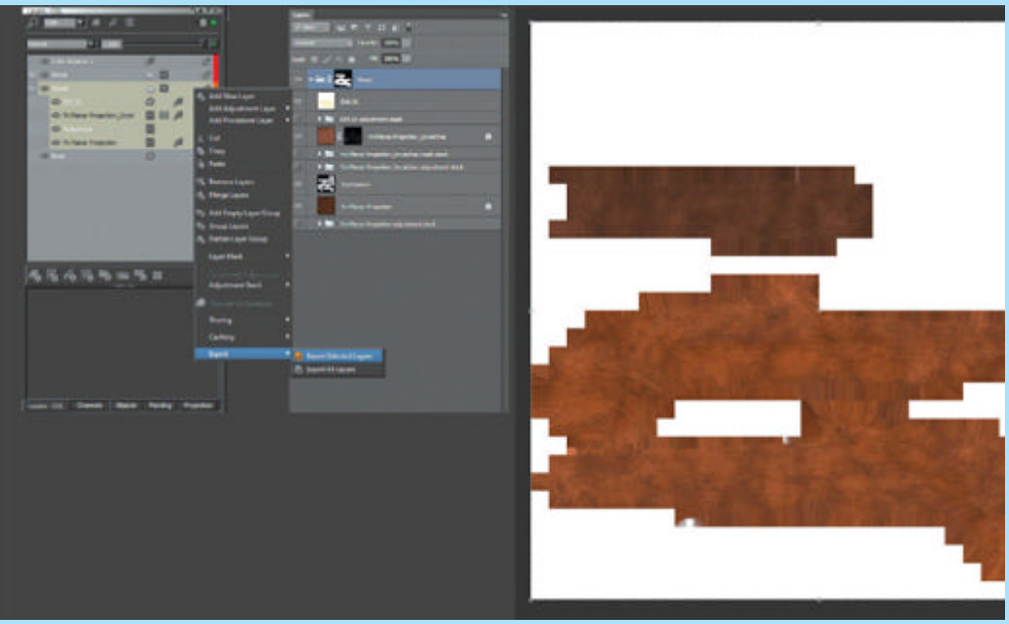
The real beauty of MARI is that artists can paint high-resolution texture maps directly onto 3D models without ever having to worry about technical issues. The software can handle millions of polygons and more UV tiles than they'll ever need. Most of MARI's modules are also similar to the ones of other 2D applications, for example Photoshop, so new users generally won't get lost when they first start learning how to use it.

The overall feeling when working with this software is that MARI has been created to take the best of what was out there and make it even better: from small tools like the multi-resolution Warp (Photoshop users are still waiting for this), to bigger features like the fully renewed Layers system of this latest version. MARI has also introduced brand-new concepts for the texturing workflow. One of these tools, for example, is the Paint Buffer, which is a plane that lets you edit your paintings before baking your work onto the 3D geometry.

While the core feature set artists are used to hasn't changed in this new release of MARI, the big update is the introduction of the new 100 per-cent non-destructive layer system. In previous releases, artists had to create channels for every single image they needed to apply to a model, and then mix those channels inside shaders through shader modules. This could cause some confusion – particularly to users approaching the software for the first time. In version 2.0, The Foundry changes this workflow: channels are not the basic components of the texture any more and all of the work is done at a layer level, in a similar fashion to Photoshop.

Channels are now like folders, with each of them able to contain as many layers as needed. Shaders on the other hand are no longer used to mix layers and are now closer to the shaders found in other 3D programs, with the new ability to plug each channel with slots – COL, SPEC and BUMP, for example – and preview the result in the viewport.

The majority of the work now is done inside the Layer Stack palette. Here, users can create different types of layers. The most common is the Paint layer, which is an empty canvas that artists can use to paint or project images onto the 3D model (similar to the Channels of previous releases). The second-most important layer types are the



MARI 2.0 can easily import and export PSD files in an existing layer stack or in a new empty channel

Be prepared

MARI 2.0 is a beast, so you're going to need a good system to run it on

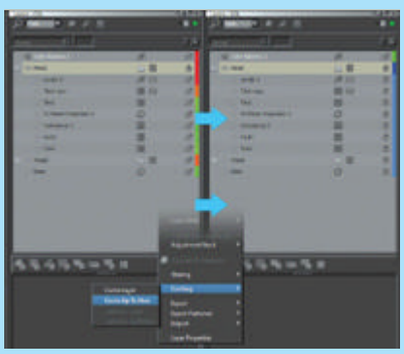
Due to the very high system requirements of MARI 2.0, in order to test it for **3D Artist** magazine I had to get my hands on some sturdy hardware. Saving the day was the HP Z820 Workstation running Windows 7 (64-bit). The system featured dual graphics processor support, 32GB of memory, a 300GB Intel SSD and the AMD FirePro W7000 4GB PCI-e graphics card. The awesome graphics card coupled with the HP workstation gave me ample power to test-drive MARI 2.0 and give it the spin it deserves. Learn more about HP workstations at www.hp.com (or www.hp.com/uk) and check out the FirePro W7000 at www.amd.com.

With Mask Groups, artists are allowed to blend as many layers as they want in each layer mask

GPU-accelerated procedurals, which are non-destructive editable layers such as fractal noises, tri-planar projections and tiled textures (previously in the Shader modules). All these layers can be blended together using the common Photoshop blending modes – and also advanced blending – to key and remove only a part of the image. Integration with Photoshop is further enhanced by the possibility of importing PSD files as layers in the Layers stack, as well as exporting layered files out as PSDs.

MARI 2.0 doesn't stop there, either. New and unique concepts have been introduced to make the layers experience even better than in rival packages. Each layer mask can be converted in a Mask Group, which is a layer stack of its own where artists can use blending, groups, adjustments and procedurals for a more flexible workflow. Layers can also be shared by Ctrl+Shift-dragging them into different stacks (or the same one) so that they automatically and instantly update wherever it's used.

If you're afraid of leaving Photoshop but curious to give MARI a try, I recommend you test it out. You won't regret it!



Layers in the stack are colour-coded: red ones are memory heavy. You can also cache them to optimise MARI 2.0's performance

Essential info

Price: £1,210 / $1,995 US

www.thefoundry.co.uk/products/mari

OPERATING SYSTEMS

- Windows, Linux

OPTIMAL SYSTEM REQUIREMENTS

- Quad-core processor
- 250GB disk space available for caching and temporary files (or a minimum of 50GB if you're working on a small project)
- At least 4GB RAM
- Display with 1,680 x 1,050-pixel resolution
- AMD/NVIDIA graphics card with at least 1GB of RAM and OpenGL 3.2 support

Layers can be shared between stacks; every tweak to any of the shared layers will instantly update all the others

The good & the bad

- ✓ The Layers system is so similar to Photoshop that you can start working with it straight away
- ✓ Shared layers will make your life much easier
- ✓ Easily handle hundreds of high-res textures on large models featuring multiple UV tiles
- ✓ Fully integrated with Photoshop and NUKE
- ✗ System requirements are high so MARI won't be right for everyone
- ✗ You can't go back once you open an old MARI project in 2.0 – be sure to archive a backup first
- ✗ Workflow for creating a shared single mask across multiple channels could be easier. Perhaps soon?

Our verdict

Features	9/10
Ease of use	8/10
Quality of results	9/10
Value for money	9/10

"MARI has never been this powerful and flexible before. Try it!"

Final Score 9/10

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Zombie Playground, Massive Black

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/ B A L L I S T I C /

Dell Precision T5600

We put Dell's completely re-engineered high-performance workstation to the test

REVIEW BY Orestis Bastounis, technology writer, UK

Dell's Precision line of performance workstations aims to meet the demands of all kinds of intensive visual-design tasks, including 3D art and other content-creation projects. With a freshly updated set of specs, the Precision T5600 can now be configured with all the latest components to improve any workflow.

Looking at a mid-to-high-end model here, we have an NVIDIA Quadro K5000 graphics card, 64GB of ECC-registered Samsung DDR3 memory and two 3.3 GHz Intel Xeon E5-2643 quad-core CPUs. This pair of processors has eight physical cores, with 16 threads available to Windows. Our T5600 also came with two 500GB hard disks, but greater capacities and an SSD is optional, as is a Tesla GPU.

Dell has put plenty of thought into making the chassis as practical as possible. It has rubber feet for vertical or horizontal mounting and can be easily opened via a latch on the side. The power supply can also be removed externally and two strong handles at the top are a great help when moving the workstation around.

Although the T5600 blazed through our tests, it couldn't match the heavily overclocked systems we've seen recently. While the dual Xeons achieved a record CPU score of 12.95 in CINEBENCH, their 3.3GHz clock frequency meant longer render times and lower benchmark scores, compared to the results from Core i7 processors running at 4GHz or higher. In the SpecViewPerf and CINEBENCH OpenGL tests the difference was marginal. However, we noticed a 1,080-pixel 3ds Max underwater scene took an extra three minutes to render. This is around 30 per cent slower than its rivals.

The power supply can be removed without having to take the T5600 apart

The Precision T5600 is a powerful workstation with excellent 3D performance

Horsepower isn't everything, though. Precision workstations are intended for all kinds of environments where reliability and uptime take precedence. They're also bolstered by Reliable Memory Technology, one of Dell's proprietary additions. This feature uses the error-correcting capability of ECC memory to prevent bad bits being rewritten to. Practically, this reduces the chance of any future system crashes or, even worse, inaccurate renders.

This configuration of the Precision T5600 is exceptionally expensive due to its enormous amount of high-quality memory and dual processors. For this reason novice 3D artists may find it more worthwhile to shop around for a lower-end, and consequently lower-spec, alternative.

Regardless, there will be long queues to purchase the T5600, which still fits nicely into both professional and academic circles. We always expect workstations fit for purpose from Dell and the Precision T5600 offers the performance to handle any task, with the reliability to stand up to heavy use.

Essential info

Price: £5,900 (ex VAT)
www.dell.com

OPERATING SYSTEMS
- Windows 7 Professional 64-bit

SYSTEM SPECIFICATIONS
- 2x Intel Xeon E5-2643 CPUs
- 64GB ECC-registered DDR3 memory
- NVIDIA Quadro K5000 GPU
- 2x 500GB hard disks

Handles on the chassis make the T5600 easy to move

The good & the bad

✓ Modern high-end workstation performance
✓ Excellent chassis with practical features
✓ Designed for reliability with ECC memory
✓ Easy to manoeuvre

✗ Expensive
✗ Relatively noisy

Our verdict

Features	7/10
Ease of use	8/10
Build quality	8/10
Value for money	6/10

"The Precision T5600 is the 3D workhorse of Dell's lineup, with performance to handle *any* task"

Final Score 7/10

Amari has unleashed the power of NVIDIA's Quadro K4000 with this offering

Armari Magnetar S16-AW750

Armari brings us our first glimpse of NVIDIA's new Quadro K4000 graphics cards

REVIEW BY James Morris, director of t-zero communications, UK

NVIDIA's first Quadro card based on its latest Kepler GPU generation, the K5000, arrived in October last year. However, we've had to wait until now to see the full range appear. With the Magnetar S16-AW750 Armari has brought us the high-end K4000, which promises to be as much of a leap in performance as the previous Fermi generation 4000, but without a high-end price to go with it.

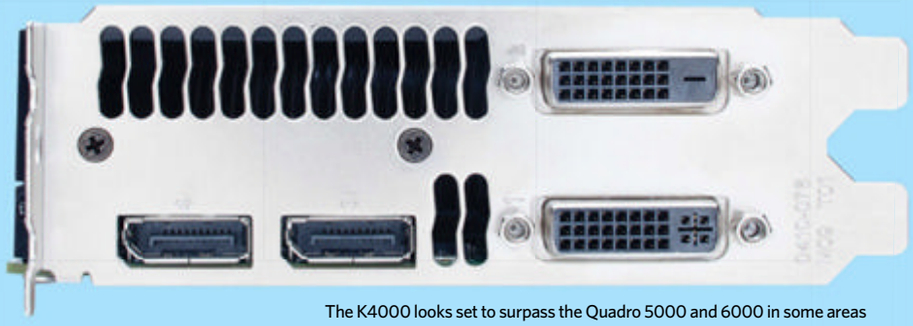
The S16-AW750 is based around Intel's Core i7-3930K processor, which runs at a nominal 3.2GHz. Armari has permanently raised the clock speed, so this CPU will run at up to 4.4GHz across all cores and has a custom water-cooling system installed to ensure that temperatures still remain under control. The 3930K is the top non-Extreme processor from Intel's Sandy Bridge generation, so offers six physical cores, which hyper-threading presents as 12 virtual cores, giving parallel tasks like rendering a boost. The processor has also been partnered with a healthy 32GB of 1,600MHz DDR3 memory in four 8GB DIMMs, leaving four slots free for upgrading to the maximum of 64GB.

This brings us neatly to the star of the show: the new NVIDIA Quadro K4000 graphics card. Numerically, this is the successor to the Quadro 4000, but its specification even surpasses the Quadro 5000 and 6000 in some areas. For a start, it sports a whopping 768 CUDA cores, where the 4000 had just 256, the 5000 had 352 and the 6000 had 448. This would imply a threefold leap in performance over the 4000, but it's not quite as simple as this.

The previous few Quadros had double-pumped CUDA units, where the Kepler generation keeps these at the same

to make the performance increase a little more muted and Kepler Quadros have reduced double-precision performance too, although this won't affect most mainstream 3D software. Memory bandwidth has also

The Quadro K4000 comes with 3GB of memory


The K4000 looks set to surpass the Quadro 5000 and 6000 in some areas

gone up from the Quadro 4000's 89.6GB/sec to 134GB/sec and the quantity from 2GB to 3GB of GDDR5.

Armari has provided an impressive storage provision, too. There's a 240GB PNY Prevail Elite Enterprise solid state disk, for super-fast main operating system and application loading, as well as a 2TB conventional Western Digital RED 7,200rpm SATA hard disk for general data. There's an 18x DVD rewriter, but this more budget-conscious Armari system doesn't include the company's usual multi-format card reader.

The K4000 doesn't disappoint when it comes to performance testing. The score of 96.69 in Maxon CINEBENCH R11.5's OpenGL test is one of the highest I have ever seen. SPECviewperf 11 results were similarly impressive, with 91.78 in the lightwave-01 viewset, 113.41 in maya-03 and 67.14 in the SolidWorks-based sw-02. All are among the best test scores I've recorded. The Armari system also managed a very healthy 12.48 in the CINEBENCH R11.5 render test, which is what I would expect for a frequency-enhanced six-core Intel Core i7.

Despite these phenomenal test results, the Armari S16-AW750 still comes in at £2,295 ex VAT, which is a decidedly mid-range price for a workstation. This sums up NVIDIA's new Quadro K4000 nicely: high-end performance for a mid-range price. It's a very exciting proposition for independent 3D content creators or studios looking to expand their seat count without breaking the bank.

NVIDIA's Kepler Quadro range

NVIDIA has taken an unusual route with its Kepler generation of Quadros

The high-end K5000 was released alongside the consumer-grade models based on the same generation about six months ago. We've seen a number of workstations using the card, with very impressive results. Sporting 1,536 CUDA cores and 4GB of GDDR5 memory, the K5000 is a formidable professional 3D accelerator. However, at over £1,300 it's also pricey. Those looking for a more cost-conscious workstation have had to wait until now for the more reasonably priced K4000, mid-range K2000 and entry-level K600.

All three new cards are pretty exceptional. The K4000 is a little over half the price of the K5000, but offers much more than half the performance, as shown in this month's review. The K2000 has an even more compelling value proposition for the professional 3D content creator on a tight budget. It offers 384 CUDA processing cores and 2GB GDDR5 memory, so has a better specification than the previous high-end Quadro 4000's 256 CUDA cores, although memory bandwidth is only 64GB/sec compared to the Quadro 4000's 89.6GB/sec.

The Quadro K600 similarly offers specifications to compete with the next class up from the previous generation. It sports 192 CUDA cores, twice what the Quadro 600 had, the same as the Quadro 2000 and 1GB frame buffer. However, this is DDR3 memory, so bandwidth is just 29GB/sec, whereas the Quadro 2000 offered 41.6GB/sec. The K2000's power consumption drops a little, too, drawing just 51W compared to the 2000's 62W, although the K600 remains similar at 41W compared to the 600's 40W. With twice as many CUDA cores, you're getting quite a bit more performance per Watt.

Overall, NVIDIA's Kepler Quadros bring unprecedented performance for the money, with the K2000 in particular providing high-end performance to low- and mid-range workstations.

*Price correct at time of printing

Essential info

Price: £2,295* (ex VAT)

www.armari.co.uk

SPECIFICATIONS

- 3.2GHz Intel Core i7-3930K running at 4.4GHz
- 32GB 1,600MHz ECC DDR3 SDRAM
- 3GB NVIDIA Quadro K4000
- 240GB PNY PREVAIL ELITE Enterprise Solid State Disk
- 2TB Western Digital RED 7,200rpm SATA hard disk
- 18x Sony NEC Optiarc DVD rewriter
- Windows 7 Professional 64-bit
- Three-year warranty: the first year on-site; second and third years RTB

NVIDIA's Quadro K4000 may be a mid-range card, but with multi-monitor support and impressive test scores, it certainly punches above its weight

The good & the bad

✓ Incredible graphics performance
✓ Good rendering power
✓ Decent storage selection
✓ Reasonable price

✗ None I can think of!

Our verdict

Features	9/10
Performance	10/10
Build quality	9/10
Value for money	10/10

"The Quadro K4000 provides awesome performance, decent rendering and can be bought on a budget"

Final Score 9/10

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AK3D
André Kutscherauer sheds light on his animation process in this charming short film

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"We've made such big improvements to the existing architecture of MODO 701," said Luxology's Brad Peebler. "601 users will notice a huge leap forwards"
Images © Andy Probst

MODO 701 is out now

The new release with a host of exciting features

Luxology has launched MODO 701, the first major update to the software since the company's merger with The Foundry last year.

The new iteration sees improvements to MODO's modelling, sculpting, animation, effects and rendering workflows, with each change made as a direct response to customer feedback.

MODO 701 comes with a new particle engine, an unlimited network-rendering feature, audio playback and a dedicated dynamics layer. Soon the program will also be available for Linux OS, meaning the software can be run on all three of the major platforms.

Perhaps less welcome will be the news that the price has gone up by $300 US, making MODO 701 $1,495 US for an individual licence, or $1,795 US for a floating licence. According to an online pricing FAQ, the increased pricepoint is attributed to the "development costs of additional OS support, unlimited network rendering and a more complete end-to-end feature offering".

You can learn more about the program and the wider range of software Luxology has to offer via www.luxology.com.

Core features in MODO 701:

- A procedural particle engine with an easy-to-use preset workflow
- Audio playback and a sound channel modifier to bring animations to life
- Schematic improvements that reduce the scene graph complexity
- A dedicated dynamics simulation layer, significantly improving performance
- Previously complex materials and layered shaders can be simplified
- Performance improvements for large scenes, by as much as 175 times
- Improvements to render preview-simulation, over 50-times faster for particularly large scenes
- A new Python interpreter, making executing Python scripts much faster
- Unlimited network rendering

The MARI 2.0 launch

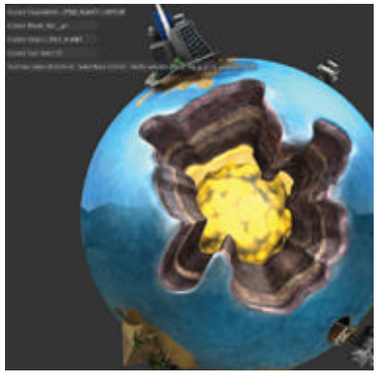
The Foundry adds layers to its 3D-painting tool

The Foundry is now shipping MARI 2 – a huge update to its digital-painting program. The core functionality here is its brand-new layering system, which should be immediately familiar to anyone who has used Photoshop. However, there are many additions here that tailor the software more directly towards a 3D texture-painting workflow.

There's a notable breadth of options in the masks and adjustment layers. Each mask is effectively a full layer stack in its own right, enabling artists to use blending, groups, adjustments and procedurals in all their masks. This enables a more flexible and non-destructive workflow.

Layers can now be dragged and dropped between stacks, while still retaining a link with those they sit between, thanks to shared layers. This means adjustments will automatically update across layers where necessary. Layers can also be displayed selectively via icons in the UI, and there are now options to search for them by tags or keywords, which is very helpful for larger multi-layered projects.

MARI 2 also introduces a range of procedural effects and options for controlling the layers' appearance. MARI 2 is out now at $1,995 US for Windows and Linux. You can learn more about the new software at www.thefoundry.co.uk.



A new layer system was actually one of the very first requests logged for MARI while it was back in its development phase at Weta Digital

● **HAVE YOU HEARD?** • ***Star Wars: The Clone Wars*** **has been cancelled, but a new animated series is in development**

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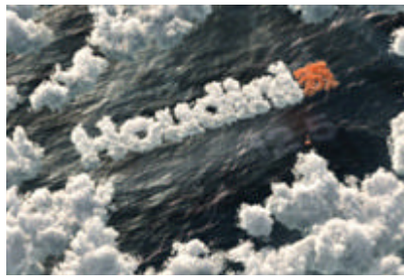
Houdini 12.5 ships

New cloud-creation and fluid-simulation systems

Side Effects Software has released a major update to its 3D animation and VFX program Houdini. One of the most major updates is the Cloud FX tools, which incorporate DreamWorks' OpenVDB volume-sculpting technology to enable users to create and render a range of realistic cloud formations.

Fluid simulation has also seen something of an overhaul, with new Ocean Waves tools that can animate ebbing surfaces and then generate FLP fluid simulations from those surfaces. The tool also uses a unified solver for generating spray and foam, as well as a separate tool for mist.

The lighting and rendering pipeline in Houdini 12.5 has also been significantly enhanced, with relighting options and optimisation in interactive photorealistic rendering. There are also a variety of additional updates to the software's Cloth, Hair and Bullet Physics simulation systems.



The new Cloud FX tools and the interaction between fluid and rigid-body simulations are impressive

Houdini 12.5 is available now for $1,995 US. Houdini FX is available for $4,495 US. You can learn more at www.sidefx.com.

Online rigging

Project Pinocchio revealed

Autodesk Labs has launched Project Pinocchio, a work-in-progress technology that will enable users to create fully rigged 3D characters in their web browser for exporting to applications like 3ds Max and Maya. When users launch the system they can choose from a range of pre-built figures covering a range of builds and proportions. They can then drag sliders to morph their own character's facial or body proportions to match the source, then export the resulting rig in MB or FBX formats. The character is assigned one of three preset rigs, with the option of either a bone-based or blend-shape-based facial rig. Visit http://tinyurl.com/PPinocchio.

The Project Pinocchio technology preview is available on Autodesk Labs until 30 September 2013

Clean up mocap

OptiTrack launches Motive, its new software platform

As a comparison, Motive plays a similar role to that of Blade in Vicon's mocap systems

Motion-capture provider OptiTrack has announced the launch of Motive, a new software platform for setting up, calibrating, solving and streaming data from its optical mocap systems. Motive promises to eliminate the complexities historically associated with mocap thanks to cleaner motion data, larger capture volumes and a tailor-made structure for production studios and research facilities. Motive is available now for $999 US. You can learn more about the release at http://naturalpoint.com.

Software shorts

Bringing you the lowdown on product updates and launches

Krakatoa SR

Thinkbox Software has released Krakatoa SR, the new standalone version of its high-volume particle renderer announced at last year's SIGGRAPH. Although the renderer is already available for 3ds Max and Maya, this release opens up the software to users of other software. Currently a single licence is priced at $495 US. You can learn more about Krakatoa and Thinkbox's other programs at www.thinkboxsoftware.com.

Octane Render for LightWave

OTOY has shipped Octane Render for LightWave, making NewTek's software the sixth package to get its own version of the GPU-based unbiased renderer. This version supports all of LightWave's geometry and deformation types, along with its Dynamics systems that include the new Bullet Physics options. Octane Render for LightWave costs €99 EUR for the open beta, which will rise to €199 EUR on its commercial release. Learn more at http://render.otoy.com.

Architectural Design Bundle

LightWave has coupled LightWave 11.5 with WTools3D's LWCAD 4.5 CAD tools, making its new Architectural Design Bundle. The bundle contains a useful set of features for arch-vis artists, such as real-world measurement capabilities, multiple lighting solutions and powerful CAD tools. The bundle is priced at $1,545 US, while registered LightWave users can upgrade for $745 US. Find out more at www.lightwave3d.com.

Affordable scanning

CADScan hopes to make 3D scanners cheaper for the masses

The device has an range of applications, including prototyping, reverse engineering and replication

CADScan has announced that its easy-to-use, low-cost, 3D-scanning system will be going into production following a successful round of publishing on Kickstarter. The scanner promises to capture an accurate, full-colour meshed point cloud in minutes, with no need for alignment or post work. The tool is compatible with all major CAD systems and can even print out duplicate objects using a 3D printer. Find out more about this exciting new hardware at CADScan 3D's Kickstarter page: **http://tinyurl.com/desktop3dscanner**.

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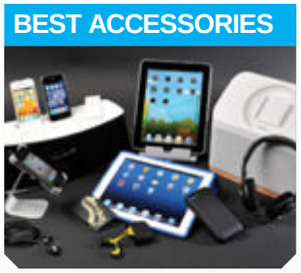

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Course Focus

Animation and Visual Effects

Build a strong foundation in animation at Bucks New University

bucks new university
Animation and Visual Effects

Course name
Animation and Visual Effects

Course length Three years

Fees £8,000 (including a personal Dell laptop)

Student requirements
200-240 UCAS points, or BTEC students with equivalent grades. GCSE Maths and English at grade C or above

Website www.bucksanimation.blogspot.co.uk

The Bucks New University Animation and Visual Effects course aims to be nothing less than the best. This is a big aspiration for sure, but the packed curriculum on offer, including animation, modelling and directing, more than prepares students for a job in the industry.

Year One sees students take on a CGI foundation, learning core VFX skills such as polygon modelling, mapping UVs, lighting, rendering and the art of compositing. A CGI Animation module imparts the principles of the topic – such as locomotion, weight and flexibility – while the Pre-vis & 3D Layout module teaches pre-production skills, including storyboarding, layout and motion capture.

The second year goes into further detail, with students gaining deeper insight into the core skills of modelling, rigging, texturing and lighting, but also exploring more complex elements such as dynamics, particles and fluids. Animation, meanwhile, is split into the disciplines of character performance, and animals and creatures.

The final year sees students galvanise all they've learned in a short film project, working through the pre-production and production phases and developing everything from the script through to the sound effects.

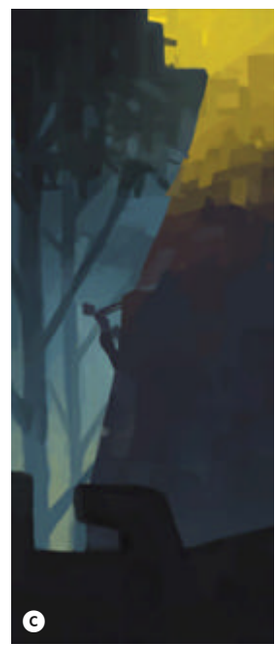
The Animation and VFX course at Bucks also boasts industry partnerships tailored to offer the finest in VFX training, with guest speakers from leading companies such as Cinesite, Framestore and MPC. Find out more at the official course blog at www.bucksanimation.blogspot.co.uk, or check out the YouTube channel at www.tinyurl.com/3DABucksVFX.

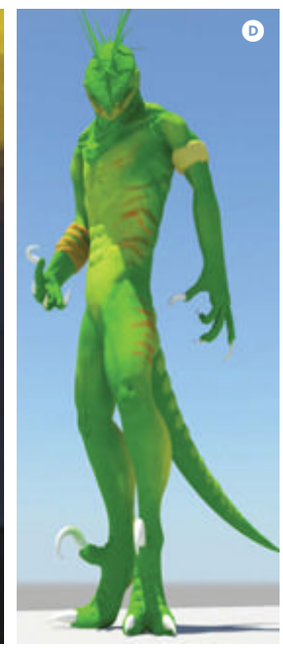
> "The tutors give you plenty of support and the course offers fantastic opportunities for a successful career"
>
> **Chris Smylie,** graduated 2010

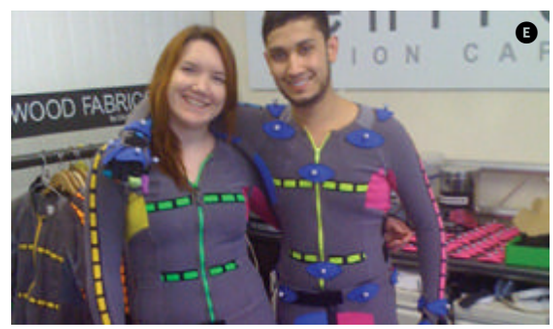
The tutor

Alex Williams

Co-course leader at Bucks New University, alongside David Creighton, Alex Williams has 25 years of experience in the animation and VFX business, with film credits that include *Who Framed Roger Rabbit, The Lion King, The Iron Giant,* three *Harry Potter* films and more. He has taught animation at many institutes including CalArts, Gnomon School and Escape Studios. He also writes and draws the cartoon strip *Queen's Counsel*, which has appeared weekly in *The Times* since the early 1990s.







A Working with arch vis
» Jacob Inerowicz
The skills students learn don't necessarily just apply to VFX or animation, but also to specific disciplines, including arch vis

B ZBrush modelling
» Vasile Edward Lupu
Students learn to use 3D programs, like ZBrush for modelling and Maya for animation, to gain a rounded grasp of the VFX toolkit

C Pre-production concept art
» Monika Dzikowicz
"The teachers encourage the most effective time management – which is a huge part of a successful project," says Dzikowicz

D Creature concept design
» Charlotte Richardson
Students learn how to create photorealistic animals, including quadrupeds, birds, insects, dinosaurs, monsters and other creatures

E The Centroid Mocap Studio
» Fiona Moxey
Students also tackle emerging technologies, such as mocap, and visit studios like the Centroid Motion Capture Studio at Pinewood

Studio Access

Crafty game design

Media Molecule discusses how it shaped a boundary pushing papercraft world

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Mm?

Media Molecule is a British videogame developer based in Guildford. Its first title was 2008's *LittleBigPlanet*, in which players could collaborate to create levels and then share the results with the online community. Recently the developer revealed a 3D-sculpting game that's due for release in the near future on the PlayStation 4.

www.mediamolecule.com

Project *Tearaway*
Description In *Tearaway* you take control of either Iota or Atoi – a pair or envelope-headed protagonists on a mission to deliver a unique, personalised message to the player. The players can directly affect the papercraft world with the touchpad on the rear of the PS Vita, using their fingers to tear through environments and damage enemies or manipulate various elements of the levels.
Software used 3ds Max

If there's any single developer out there synonymous with creativity, it's Media Molecule. The studio has created the likes of level-creation platformer *LittleBigPlanet*, and more recently took to the stage at the PlayStation 4 launch event to showcase its new 3D-sculpting game concept.

The latest title from the company is a PS Vita project that's perhaps less ambitious in scope than those mentioned, but no less creative. It's inspired by a somewhat unexpected source: "The game came from our desire to make something really tactile, something that you'd really *feel* in your hands while you play it," remembers senior technical artist Stefan Kamoda. "As we tried to work out what this world might look like, our desks piled up with concept art, until the landscape of our desks covered in paper became the actual inspiration!"

The result is *Tearaway*. Embodying the studio's familiar handicraft charm, the game places you in control of Iota, a cute delivery boy who inhabits a world built entirely out of paper. Everything from the animals to the architecture to the plantlife is folded, curled, bent and creased into charming 3D papercraft constructions.

"By building a digital world out of this one material we've been able to fully explore its properties," Kamoda continues. "It responds to every footstep of Iota as he progresses through the world and can be unfolded, unpeeled, torn or trimmed by the players guiding him."

In order to achieve this delicate paper-thin world the team at Media Molecule built an in-house editor, which enabled them to quickly put together any creations the game required. "Off-the-shelf DCC packages just aren't designed to easily make the kinds of shapes and animation we need for our world," explains Kamoda. "The in-game editor is pretty much a stack of infinite paper, a cutting mat, some glue and a pair of scissors. It enables you to create forms in terms of cuts, tears, folds and bends instead of skin modifiers, bones and vertex welding. It's incredibly powerful."

> "The in-game editor is pretty much a stack of infinite paper, a cutting mat, some glue and a pair of scissors"
> **Stefan Kamoda,** senior technical artist

Although these quirky paper features were rather fun to implement, Kamoda admits that they're not the sorts of elements you would ordinarily see included in a videogame: "In *Tearaway*, players will experience things like scenery tearing itself in two, or bits of paper flattening as Iota runs over them, so there's the challenge of implementing [these aspects] afresh for the first time. In addition, graphics hardware and standard algorithms are geared towards rendering solid objects, not thin layers of paper! As a result, Z-sorting had to be handled in a

Contributors

TEARAWAY

Rex Crowle
Lead designer

Stefan Kamoda
Senior technical artist

David Smith
Technical director

Portfolio highlights

2013 *Tearaway*
2011 *LittleBigPlanet 2*
2008 *LittleBigPlanet*

Ⓐ *Tearaway*'s lead designer is Rex Crowle, a graphic designer and animation director who has worked for BBC, Disney and MTV in the past. You can see a collection his work at **http://rexbox.co.uk**

Ⓑ

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C

D

E

F

special way and it was harder to fix those annoying shadow-mapping glitches."

These challenges forced the team to create their own tools, such as a new 3ds Max plug-in that Kamoda developed personally. "At first we struggled to get our characters to match the look and feel of the game world," he says. "Our initial characters were very box-like and difficult to animate, so the default 3ds Max tools meant [models] would often deform in a very un-paper-like fashion.

"However, as the art style developed, a common theme of paper strips and loops began to emerge," he continues. "At first these were mostly used for arms and legs, but increasingly we started to use them for

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Kamoda discusses the distinctly texture-less world Media Molecule has created

"Initially our objects were fully textured in the popular papercraft style, with details like template cut and fold lines and illustrated surfaces. As we moved away from the better-known papercraft style of construction, we realised we didn't really need specific texture details as much. It was hard to let go of hand-painting all that nice detail, but thinking only in terms of cutout shapes really helped us to define a unique aesthetic for *Tearaway*. Also, not having lots of textures freed up a lot of memory to use on extra paper details, so it's been a big win in all."

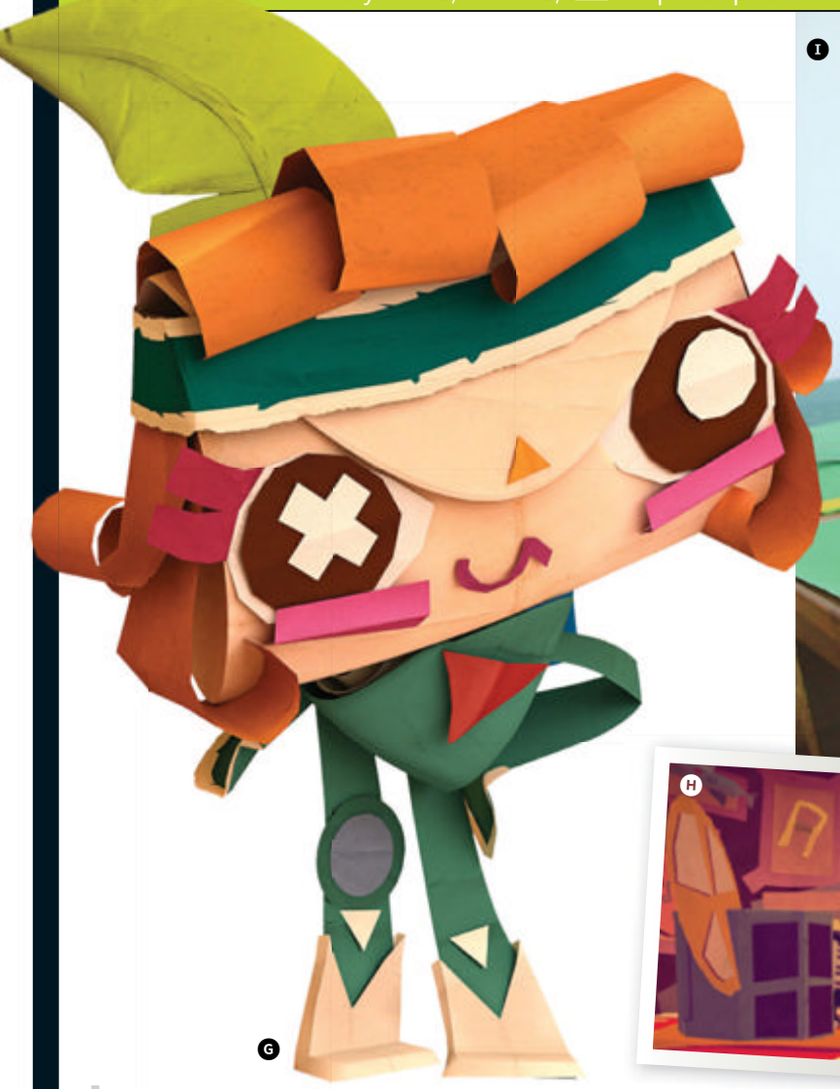
B Players aid Iota in his journey using the touchpad on the PS Vita's rear. Placing a finger on the game pad allows the player to effortlessly tear through the world and directly affect its inhabitants

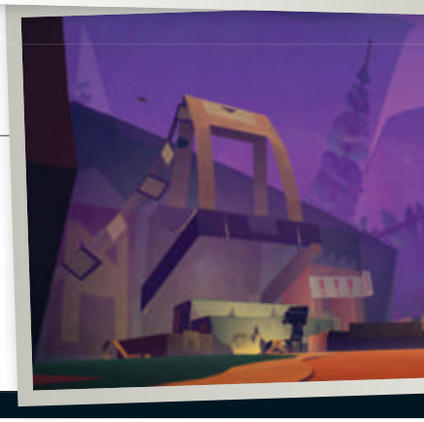
C Throughout the game players are awarded special papercraft templates. Players will be able to print these templates out, then build the characters and objects featured in the game – in real life!

D Strips of paper such as these are used to build characters throughout the world. A special 3ds Max plug-in had to be developed in order to get the paper to bend and morph in the desired manner

E The physics of the world react just as paper would in reality. Iota can use an accordion to blow gusts of air and knock down platforms, or even use glue pathways to walk on the walls and ceilings

F Media Molecule developed a custom DirectX viewport shader that imitates the shading style of the game and a variety of scripts. This made exporting *Tearaway*'s characters slightly easier





entire characters. The 3ds Max plug-in made animating these types of shapes easier by automating things like the stop-motion effects and crumpling. It also let us control how these paper strips fold and bend.

"Another challenge the plug-in helped us deal with was unwanted stretching in the rigs," Kamoda continues. "Paper doesn't [extend], but sometimes a little bit of stretch is exactly what a pose needs. To help with this, the plug-in also enabled us to draw an indicator line down the centre of a given form to display how much stretch or compression that form was under. We could use these indicators as a guide to how much the character was off-model on any given pose."

The stop-motion effects already mentioned were created by skipping frames in the animation cycles of *Tearaway*'s characters – something that has instilled the game with a *Clangers*-esque charm. "Initially, the characters were all animated at 30 frames per-second, but they didn't fit the world they lived in," Kamoda elaborates. "We found that playing our animations at a reduced frame rate, as well as introducing some accidental noise into the rigs, really helped sell them as physical stop-motion characters. We also created a plug-in that enabled us to animate things like the eyes and mouths in a stop-motion fashion. Instead of morphing between

Papercraft design

Kamoda explains how the in-game models can be printed and constructed in real life

"For the characters we usually started with a paper or card concept model, as [they feature] so many imperfections and construction limitations that only become apparent when you actually try to build something. After this a digital model could be built. It's usually the case that the UV template can be printed out and used to make the physical model again. Forms built in the World Editor are constructed in a very real-world fashion too, so it's also possible to print construction templates for those."

G The PS Vita's camera can be used to capture real-life images and then decorate various objects. Players can also blow into the microphone to create an in-game wind that lifts folds of paper

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shapes or using bones, we had a library of eye and mouth shapes we could swap between."

This approach to animation required prudent consideration of animation cycles. "We had to be careful with our poses," continues Kamoda. "Working on twos or threes means that you really have to pay attention to each drawing, as they are going to be seen for twice or three-times as long. This really emphasises the importance of the pose."

It's wonderful to think that this endearing and imaginative papercraft world came from something as mundane as untidy desks. The fact that Media Molecule can find such colourful inspiration in something so ordinary only strengthens its standing as gaming's most creative developer. We're excited to see what it comes up with next.

Tearaway will be out on the PS Vita later this year.

> "We also created a plug-in that enabled us to animate things like the eyes and mouth in a stop-motion fashion"
>
> **Stefan Kamoda,** senior technical artist

H The virtual world of *Tearaway* is every bit as colourful and charming as any Media Molecule has created before. The main playable characters, Iota and Atoi, are equally endearing and loveable

I The Media Molecule team is a rather creative bunch. The office is currently filled with scraps of colourful paper and the developer has hosted a series of paper-themed competitions on its blog

J *Tearaway*'s animation cycle was deliberately programmed to miss out certain frames. The result is an environment with a slightly juddering stop-frame aesthetic, which adds to the quirky papercraft style

K Even environmental effects, such as water ripples, emanate as stop-motion paper rings. "They're a series of mesh frames that get played back, like a 3D-animated sprite," says Kamoda

L Iota and Atoi were developed over several weeks of prototyping and modelling work. Getting the balance between their tiny paper-thin bodies and large envelope heads was essential

Project Focus

'Selfillumination'

André Kutscherauer sheds light on the animation process behind his renowned bulb-headed character

Project 'Selfillumination'

Description Based on André Kutscherauer's impressive 'Selfillumination' series from over the years, this animated version sees the bulb-headed character search for ways to light up his noggin, without being constrained by a restrictive cable. When he finally finds a way he can't help but tap dance with joy.

Company AK3D

Country Germany

Bio André Kutscherauer is a 3D artist based in Munich, Germany. He has visualised thousands of designs for a major household appliance manufacturer and creates 3D animations for marketing and advertising. In addition to his main activities, he works on free art projects, is a published author and is a freelance lecturer at universities.

www.ak3d.de

You may recognise the light-bulb character featured in this animation, as he's been knocking around in the CG community for quite some time now. Created by German artist André Kutscherauer, the bulb-headed character started out life as a demonstration of his maker's skills with 3ds Max and mental ray. However, the series also presents a metaphor for self-fulfilment, restriction and the dark side of success.

Now, many years after first envisioning the character, Kutscherauer has returned to his much-loved 'Selfillumination' series, but this time has endowed the character with motion in a splendid animated short. "The film tells the story of how the light-bulb guy is still searching for ways to keep shining, without being restricted," says Kutscherauer. "He finally finds a compromise between shining and freedom. Like my previous works, this is again a mirror of my current situation."

In order to properly animate his long-running character, Kutscherauer turned to the powerful 3ds Max Character Animation Toolkit (CAT). "This was the key tool for me to realise the short," says Kutscherauer. "What impressed me with CAT was its complete procedural workflow. As all motions can be layered, I was able to build up a workflow almost like in Photoshop.

"At the bottom I had a layer called 'Transportation' that dealt with all the work cycles automatically," continues Kutscherauer. "On the second layer was the animation of the upper body. Besides that I had some different layers for Forward Kinetic and Inverse Kinetic animation-blending, and so on. As you can easily blend these motion layers with a simple number it was really fun to animate the whole thing."

The animation was produced as one shot, meaning CAT had to work with a lot of different requirements. He explains: "When the figure picked up the plug, the arms were bound to the plug and the FK had to switch to an IK. If the figure started to cycle on a bike, the feet had to be controlled by the pedals. All of these needs were really challenging for me to realise as it was my first character animation, but thankfully CAT is a really reliable tool."

Plugging in

Kutscherauer lists the many useful plug-ins that helped light up 'Selfillumination'

"Personal projects such as this are a playground for me to try out techniques I would never usually use in my daily business, so I applied a lot of plug-ins for this animation. For the 3D elements I made use of Vue xStream, StereoCam Modifier, BetterWind Modifier, Particle Flow Tools, FumeFX, Frost, Krakatoa and nPower Translators. When working on the 2D elements I used ReelSmart MB, Particular, Magic Bullet Looks and a lot of scripts for specific tasks. Without these plug-ins, a lot of the scenes you see would not have been possible."

The artist

André Kutscherauer
Artist/animator

> "I always intended to animate this figure. A rough script was shaping in my head while I was working on other projects" **André Kutscherauer**

A Kutscherauer has been working with this series for many years now, with each image depicting something metaphorical about his own career. In this latest project he decided to not only animate the character, but also present him in stereo

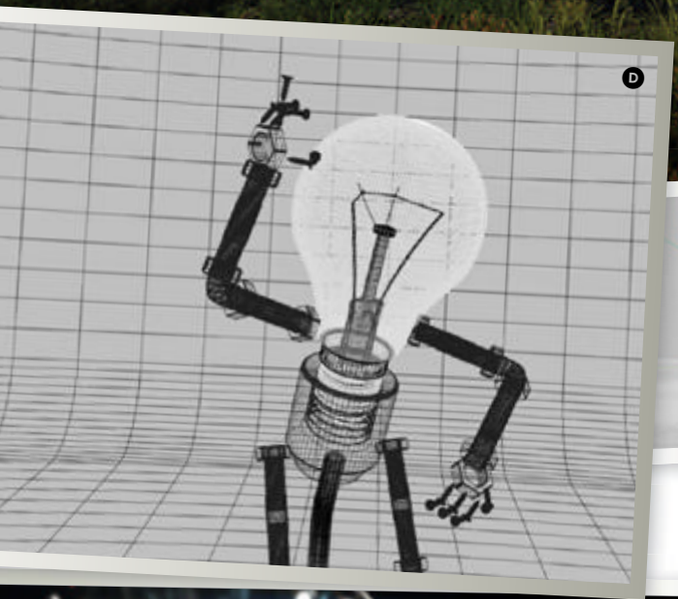
B The fluid change of lighting in the short proved a challenge. While dancing, the bulb-headed character transitions from indoor studio lighting to outside natural lighting. Kutscherauer achieved this change through the careful use of layers

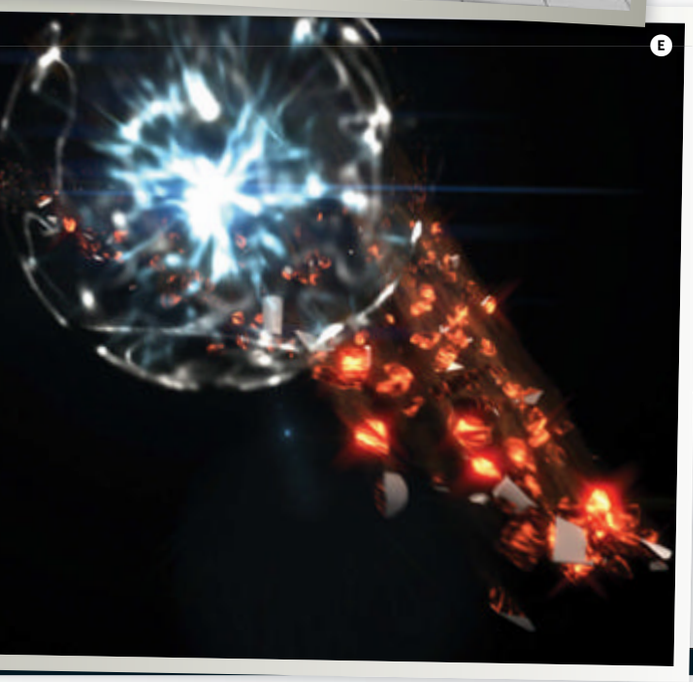
C The natural environments encountered in the short were created using E-on Software's Vue xStream. The scene is based on a real area called Sylvensteinspeicher, which is located near Kutscherauer's home in Munich, Germany

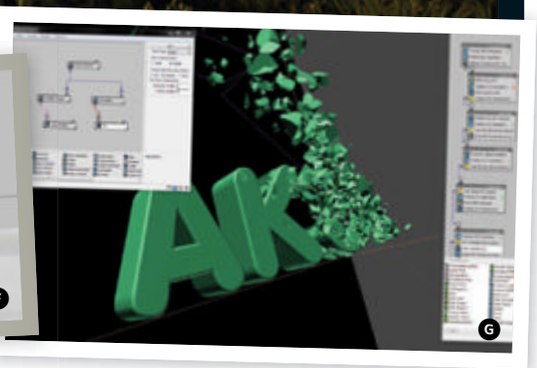
D Kutscherauer found the 3ds Max Character Animation Toolkit extremely useful on this project. Its ability to layer motions in a workflow similar to Photoshop was particularly handy. "I was able to realise all scenes in the most intuitive way I could imagine," he says

workspace

To submit your project to the **workspace** please contact Chris McMahon at **chris.mcmahon@imagine-publishing.co.uk**







Kutscherauer didn't just stick to traditional CG animation, though. He also delved into the world of mocap. "For the tap dance I got an incredible offer from Critical Moves to mocap a custom sequence of my choice," he tells us. "I always had a scene in mind where the figure gets his power from a solar umbrella, so I chose to have him tap dance to *I'm Singing In The Rain*.

"It was a challenge because of the complex dance and the proportions of the light-bulb guy – he has a really big head and no neck," continues Kutscherauer. "The dancer had to move the umbrella in an uncommon fashion so as not to collide with the glass bulb of the figure. Critical Moves found someone who was able to dance this complete sequence and then did a complex retargeting task to get the motion to the final figure. They even recorded the tap sounds on a wooden ground!"

The result is a charming short that breathes even more life into a character already full of CG-driven personality. You can watch it in full – in both 2D and stereoscopic 3D – at www.ak3d.de.

E The decision to add motion blur to the short increased Kutscherauer's render time by about a month. However, he was adamant that only fully rendered 3D motion blur would have the quality he aimed for. As he tells us: "Patience is a virtue!"

F Given that he works in product design, the final look of the project was key to Kutscherauer. When it comes to rendering and lighting he has a simple rule: "Do not fake anything! If it's too dark, don't fix it in post, but replace the light correctly"

G The film's opening logo is impressive, with Kutscherauer using tools such as Krakatoa and FumeFX to achieve a stunning effect that features 50 million simulated particles. It was the first time he'd attempted something like this

Industry insider

Animating anatomy

Lead medical animator

Brett Murrah describes how medical animation blends the worlds of art and science

About the insider

Job Lead medical animator at XVIVO

Education BA in Communication, Central Connecticut State University

Location USA

Biography Brett Murrah is a 3D medical animator living in Connecticut. Although starting out his education in TV, editing and film classes, he eventually taught himself animation using LightWave. Despite a short stint in freelance and working on particle effects for a videogame, the majority of his career has been based in the field of 3D medical animation.

www.xvivo.com

CG animation is a wonderful tool. It can bring dinosaurs to life, send us out to the far reaches of the Solar System and even show us what's occurring within the microcosm of our bodies.

As a lead medical animator, it's Brett Murrah's job to illustrate the microscopic goings-on of our anatomy, taking difficult concepts and representing them in as clear and understandable a form as possible.

However, it was a love of animation, not medicine, that brought him to this point. "After college I ended up completing an internship at a company that did some video editing," he tells us. "I knew that 3D animation was booming at the time and ever since I saw… movies with effects like *Jurassic Park* and *The Abyss*, I knew I had to learn as much about 3D animation as I could."

What does medical animation involve, exactly?

At XVIVO I work on a variety of medical animations for pharmaceutical companies. A lot of these companies make various drugs or medical devices for all different types of health issues. We have to help them deliver the message of how these items work in the body. If a drug helps to reduce cholesterol then we show, through artistic vision, the journey the drug takes. [We also show] how it works and interacts inside the body, all the way down to the cellular level.

Did you have a great deal of anatomical experience before working in medical animation?

My anatomical experience was fairly limited before I began doing animation. I knew where some things were – parts of the body, bones, muscles and various systems just stuck, like a map. So I always knew them. However, more complex things like cells and their intricate functions are harder to understand. If I don't understand them, I just go and research. I know and work with a lot of medical illustrators and scientists, so I wish I knew as much as they do!

How does the medical animation pipeline differ from traditional animation?

Working with such a small group of artists lets us pass information back and forth easily. Basically, we become the Jacks of all trades, in that we don't have specific people for different parts of the job. An artist can take a shot from start to finish. Personally, I can model, texture, light, animate, make a camera setup, render, composite and edit a whole video.

How do you go about creating microscopic imagery?

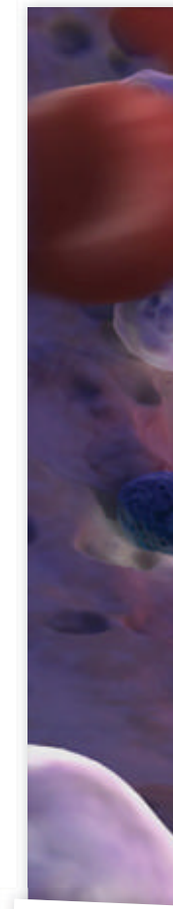
We use a lot of different reference materials to create our final images. Sometimes we use research papers based on a certain topic. There are also diagrams and images in medical books that we can turn to as well. And we have a small library full of reference material we can pull from.

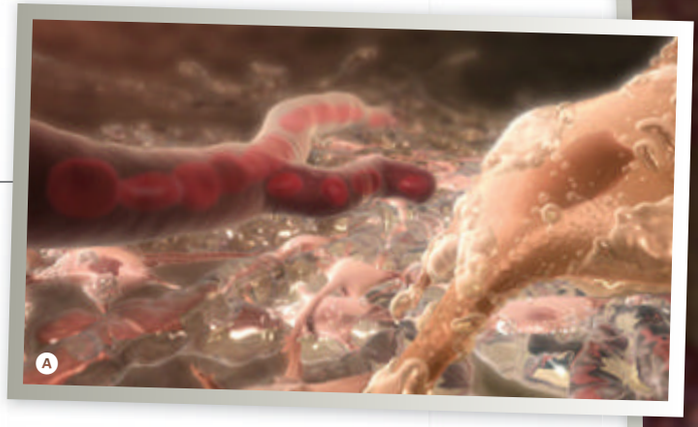
To get the looks we do, we use a range of 3D software packages, including LightWave – my personal favourite – as well as Softimage and 3ds Max. Some of the molecular models we can build are from files called PDBs (protein data bank). These are libraries of molecules and drugs that have unique structures… [These] are the same as the exact structure or drug that a client needs us to replicate. Occasionally we also model structures from scratch, when we can't just pull them from the library.

Is there much simulation work in medical animation?

It really depends on the project. Most require traditional keyframe animation, but some commissions call for specific motions or molecules to be attracted to one another, so simulations help a lot. Some of the undulating and jiggling motions to certain cell surfaces and interactions can also be simulated to get a higher-quality look.

Simulations can be costly, so if there is another method to achieve a similar result I usually opt for that. With software becoming easier to use and computers becoming faster, our jobs get easier and we can focus more on what counts – the art and science of the job.





CREATE A SCAN EFFECT IN LIGHTWAVE
Tutorial by Brett Murrah
Page 84

Portfolio highlights

Some of the projects Brett Murrah has worked on include:

2013 *Unlocking the Mysteries of Extracellular RNA Communication*
2012 *Pangea*
2009 *Return to Wholeness*
2008 *CT Science Center interactive displays*
2007 *The Inner Life of the Cell*
2006/07 *Galactic Bowling/Alien Monster Bowling League*
2004 *The Cure*

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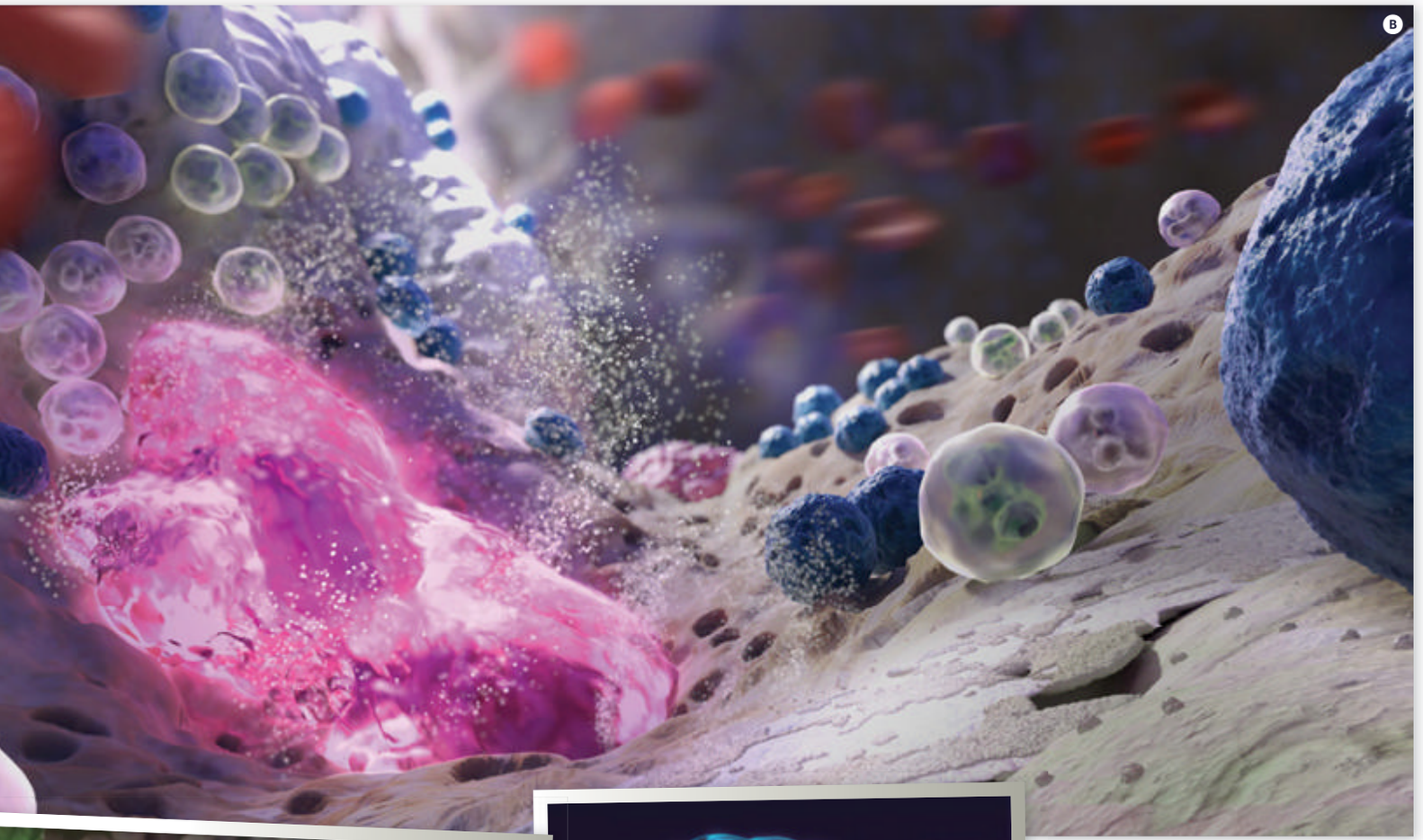

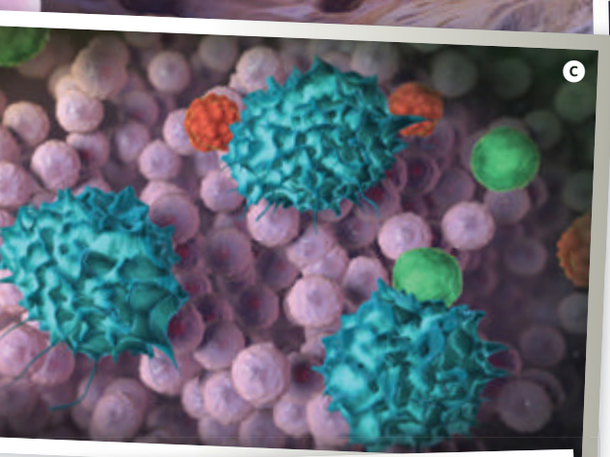

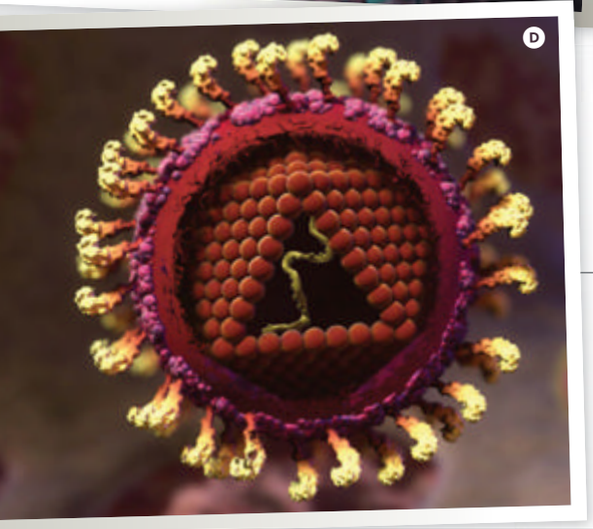

All images © Michael Astrachan

Microscopic CG

Murrah discusses how his team makes the extremely complex seem incredibly simple

"Usually we work from storyboards and scripts to keep things understandable. There is a lot of back-and-forth communication with clients to ensure we are imparting a clear message to the audience. There are a lot of revisions at the script and storyboard level to help ease any issues when we go to animate. New research is being done all the time, which can cause major revisions at the last minute, so at XVIVO we do our best to have things running smoothly from the off."

> "With software becoming easier to use and computers becoming faster… we can focus more on what counts – the art and science of the job"

A Murrah tells us that projects featuring medical machinery and utensils can be more difficult than organic projects, given the physical accuracy required

B Although a robust medical knowledge is not necessarily a requirement for a medical animator, having at least an interest in the subject certainly doesn't hurt

C Medical animators will very often work on multiple artistic styles within the same month, in order to meet the varying requirements of their many clients

D Some lesser-known tools used by medical animators are PyMOL and UCSF Chimera. These programs are used for visualising at the molecular level

E At Murrah's company, XVIVO, many of the artists straddle multiple disciplines and often work single-handedly on a project, from start to finish

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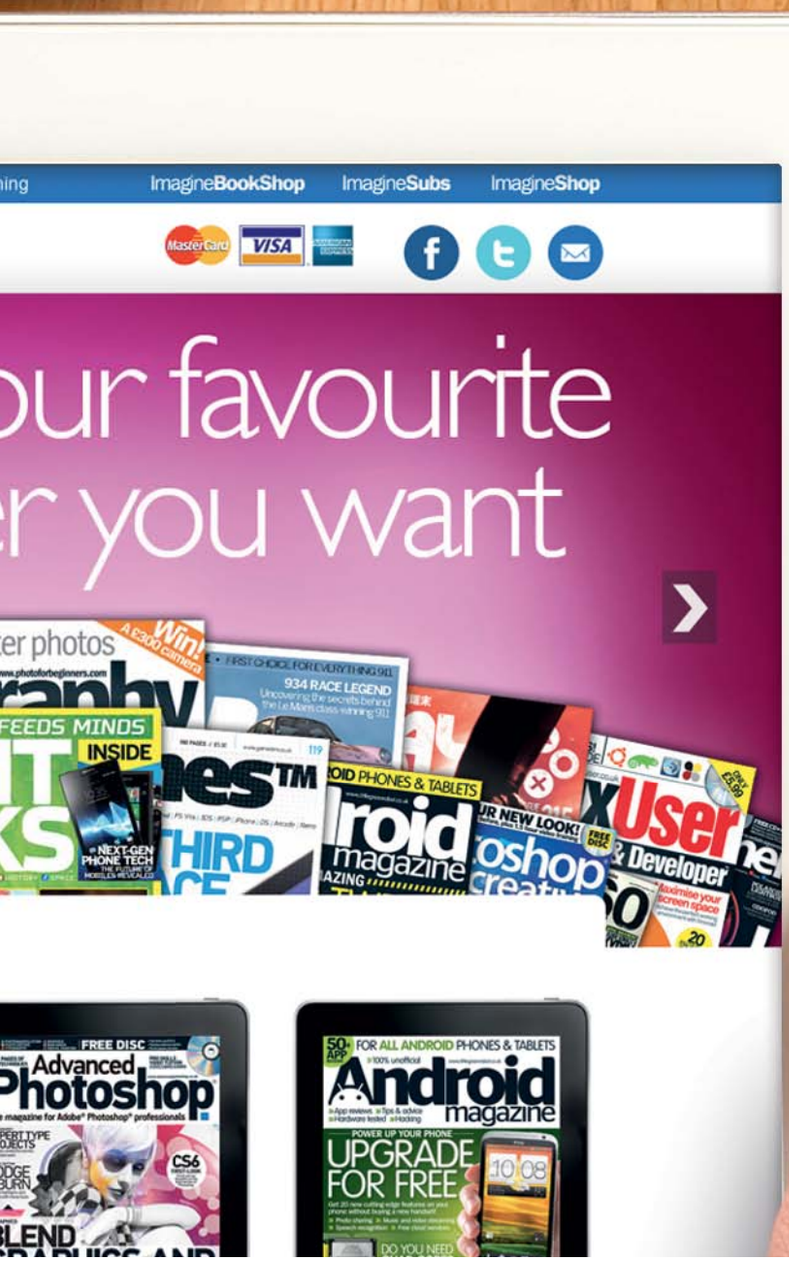

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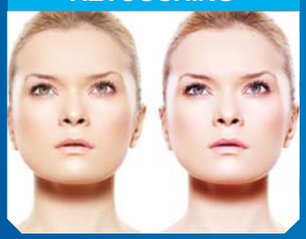			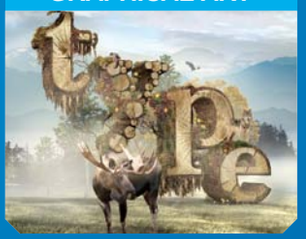	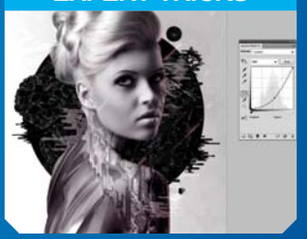

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The Digital Animation & Visual Effects School

James McDonald
Student at the DAVE School

James, how long were you at the DAVE school before you created this sculpture?
"This was modeled and textured in my first 10 weeks of training here at the school."

What do you like best about the school
"The thing that I like best about the school is the range of real world work experience you get. In the time that I have been here, I have worked on 3 separate real world productions. This is experience that would be very difficult to come across without the DAVE school."

What are some key skills you have learned at the DAVE school that let you create such a beautiful model?
"The main skill that the DAVE school taught me, which I used to create this model was the Lightwave to ZBrush pipeline. Skills like being able to easily model and UV the object in Lightwave then send it to ZBrush for sculpting, texturing and map generation, then back to Lightwave for lighting and rendering. Learning all this ensured that the model was delivered at the highest quality, and within the deadline."

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This render was based on original concept art by Alex Legg.
See more of Alex's work at Alexlegg.co.nz

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